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Francis C. Yarnall.

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THE

PRINCIPLES

OF

BEAUTY IN COLOURING

SYSTEMATIZED.

BY

D. R. HAY,

DECORATIVE PAINTER TO HER MAJESTY,
EDINBURGH.

WILLIAM BLACKWOOD AND SONS,
EDINBURGH AND LONDON.

MDCCCXLV.

TO

DAVID ROBERTS, ESQ. R.A.

THE COMPANION OF MY BOYHOOD, AND FRIEND OF MY RIPER YEARS, WHO, BY HIS TALENT, ENTERPRISE, AND INDUSTRY, AS AN ARTIST, HAS DONE SO MUCH HONOUR TO HIS COUNTRY, AND WHO, BY HIS GOODNESS OF HEART AND AMIABLE DISPOSITION, HAS SO ENDEARED HIMSELF TO HIS FRIENDS, I DEDICATE THIS VOLUME AS A MARK OF MY CONTINUED ESTEEM AND REGARD,

D. R. HAY.

EDINBURGH,
90 George Street, July 1845.

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PREFACE.

To those who do not pretend to the possession of a high genius in respect to colouring, but whose physical powers of vision are tolerably correct,—who are possessed of an ordinary degree of understanding, and are sufficiently unprejudiced to receive an elementary lesson from one like themselves, this Treatise, I presume, may be of service. To some of those it may be useful in so simple a matter as enabling them to arrange properly the colours of their dress; others may find it of use in the arrangement of the furniture of their dwellings, or the plants in their flower-gardens; while to a third class, whose professions involve an attention to the laws of harmonious colouring as a constituent of beauty in their works, it will be especially serviceable.

Generally, I believe, an acquaintance with its contents may be the means of leading to a more correct appreciation of one species of visible beauty, widely diffused throughout nature, and often forming a characteristic feature in works of high art.

D. R. H.

Edinburgh,
90 George Street, 21st July 1845.

ON THE

EFFECTS OF VISIBLE BEAUTY UPON THE MIND.

On examining into the nature of physical sensation, and its connexion with the powers of the mind, it seems evident that an intermediate link in the chain, by which that mysterious union is effected, is the faculty we possess of appreciating visible beauty.

We find ourselves, in numerous cases, excelled by the lower animals, in the degree in which their organs of sense are susceptible of receiving impressions from external nature, but this susceptibility is of an exclusively physical kind, and, although, it may, and does lead in some animals to acts of memory, and consequently of association, yet it never, in the slightest degree, so far as can be ascertained, reaches the æsthetical faculty of an appreciation of visible beauty. This faculty then, it would appear, has been conferred on man alone, and forms, therefore, one of his distinguishing attributes.

ON THE EFFECTS OF VISIBLE BEAUTY UPON THE MIND.

Visible beauty is of two kinds;—the first arising from harmony of Form,—the second from harmony of Colour. When combined in one object, these qualities enhance each other, and, indeed, ought always to be associated; for no colouring will ever render a deformed object beautiful, neither will the most perfect configuration ever render a discordant arrangement of colours pleasing, although the one kind of beauty may be admitted as the ruling principle in a subject, and the other merely as an accompaniment. Such arrangements, indeed, often present themselves, and are fully appreciated, without our being aware that their beauty is so constituted. As an instance of this, I may refer to the universal concurrence of mankind in appreciating the peculiar beauty of white marble statuary. That the principal constituent of beauty in such works ought to be harmony of form, no one will deny; but this is not its only element, as appears from the fact, that a cast in plaster of Paris of a fine white marble statue, although identical in form, is far less beautiful than the original. Now, this is evidently in consequence of its being changed from a semi-translucent to an opaque substance, and being thus deprived of that exquisitely harmonious blending of the three primary colours to which the balance of the transmission and reflection of light gives rise. This balance acts reciprocally upon two opposite principles in colour, namely, warmth and coolness, the one being the natural result of the partial transmission of light through any substance, which, being semi-

opaque like white marble, reflects the other. Thus we have in the remains of Greek sculpture, the nearest approximation to the *beau ideal* of beauty in form of which human intelligence is capable, accompanied by a species of natural chromatic harmony in the soft blendings of the light and shadow which their configuration necessarily produces.

All the beauty of Nature's colouring arises from contrast, or the operation of two opposite principles, amongst which those just noticed most distinguish colours; and although the various modes in which they operate can only be discerned by careful observation and study, yet the beauty thus produced, is fully appreciated by the generality of mankind. When we gaze upon a cloudless sky, we are struck with its beauty, yet here there is no form—no configuration—and apparently only one colour. Now, as we know that there can be no more beauty conveyed to the mind, through the eye, in viewing one individual colour, than through the ear in listening to one single continued note, we are apt at first to imagine that the organ of vision has in some measure conveyed a false impression to the mind. But this is not the case. What I have endeavoured to explain in regard to the effects of light in its action *upon* and *through* white marble, in reflecting coolness and transmitting warmth, applies equally to the common atmosphere in which we move. When that which lies behind it is dark, it reflects light to the eye in those cool tones of blue, gray, and purple, which seem to clothe the distant mountains;

but when it transmits the clear light of the horizon, it does so in numerous warm tints, the extremes of which produce the gorgeous effects which so often accompany the setting sun. We have, therefore, in the upper part of a clear sky, where the atmosphere may be said to be illuminated principally by reflection from the surface of the earth, a comparatively cool tone of blue, which gradually blends into the warm tints transmitted through the atmosphere from the accumulated light at the horizon. Such a composition of harmonious colouring is to the eye what the voice of the soft breath of summer amongst the trees, the hum of insects in a sultry day, or the simple harmony of the Æolian harp, is to the ear.

When we examine the more palpable examples of Nature's colouring, we shall find in that which clothes the general face of the earth, a continual exemplification of the beautiful effects produced by the combination of the opposite principles of warmth and coolness; and this may be traced throughout all the ramifications of the vegetable kingdom, from the largest objects to the most minute. It is the same in regard to the colouring exhibited in the animal creation; for, as the colouring of every single leaf of a plant or petal of a flower exemplifies the operation of fixed laws of harmony, so does each feather of a bird, scale of a fish, or hair of a quadruped, afford a separate object, by the minute examination of which the visible beauty of harmonious colouring is developed.

There is thus conveyed to the mind, through the sense of vision, a kind of pleasure, as much superior to physical sensation as intellect is to instinct, the reflection upon which, assists in leading us to the conviction that we have an immortal nature, and that it is capable of sublimating the impressions made by matter upon matter, exemplified in the sensations with which external nature affects our senses.

The perception of beauty is the first of the mental faculties that developes itself, for, if we trace back our feelings to the earliest periods of childhood to which memory can lead us, we shall find it even then in operation, and producing an excitement, which all our subsequent experience fails to enhance. It is no doubt true, that an appreciation of the beauty of colouring depends, in the first instance, on the physical powers of the eye, in its capability of receiving true impressions from the action of light. We may, however, possess a good eye for colour, and, by experience, be enabled to make nice distinctions between the relative qualities of tints and hues, in respect to their purity or intensity, without possessing the higher power of appreciating, to any great extent, the harmonious beauty which is so profusely developed in Nature's colouring, and which the artist attempts to imitate.

The principles which constitute this beauty are to be fouud in certain mathematical combinations or motions of the elements of matter, which are responded to by a similar principle

of appreciation implanted in the human mind; and a knowledge of the modes in which these principles mutually reciprocate to each other, forms the basis of the science of æsthetics. By the study of this science the perceptive faculty may be cultivated and improved, and a just appreciation of what is most beautiful amongst the variety of objects which nature presents to the organs of vision attained. Such a study also enables us to form correct judgments as to works of art, while it assists the artist in selecting proper objects for imitation.

The physical powers of the eye are often defective in regard to the reception of impressions, from the peculiar action of light that constitutes colour, while the impressions that are made by those modes of action that constitute light and shade are received with accuracy. This defect in the visual organ has sometimes reference to one of the primary colours, sometimes to two, but most generally to the whole three; and between this total privation and the most perfect power of appreciating colours, there lies an endless variety of degrees. But, like the appreciation of the harmony of sound, mankind generally possess it to such an extent as to offer a continual source of pure and intellectual pleasure, while some have it in such perfection as to enable them to transfer to works of art a vivid imitation of the infinitely varied tints of the general aspect of nature; or, what is a still higher mark of genius, a representation of that perfection of colorific beauty peculiar to the human countenance.

ON THE EFFECTS OF VISIBLE BEAUTY UPON THE MIND.

To attempt to convey a knowledge of what constitutes harmonious colouring to those whose organs of vision are naturally defective would be a useless labour; and to pretend to instruct the man whose intuitive genius enables him to feel and imitate the infinitely various and beautiful combinations of Nature's colouring, would only be an act of presumption. But to the incalculably more numerous class who stand between these extremes, I may freely address myself; and, while I continue to impress upon them the advantages derivable from an attention to the first principles of beauty in the ordinary requirements of life, it is with a view to assist in making one step towards a higher degree of civilization.

We may estimate the prosperity of a nation by the general enjoyment amongst its people of the necessaries and luxuries of life, but we can form an opinion of its intellectual refinement only by the manner in which the first principles of taste are exhibited along with such enjoyment. The decorations of temples and other public buildings form no true criterion of judgment in this respect. These, for the most part, are the works of great artists, and great artists but seldom appear upon the stage of human life. Such men possess intuitively a knowledge of the principles to which I have alluded; but although the same degree of knowledge can never be imparted by instruction, yet such a general understanding of the principles alluded to may be diffused amongst a people as to elevate the character

of the most simple attempts, and thus assist in rendering its effects visible through all the ramifications of society. But, with all our Academies of Art, Schools of Design, Institutes, Associations, &c., there has as yet been no such general dissemination of these first principles, and, consequently, there exists no statutes in the republic of art, no code of laws for the guidance of public opinion, in forming its judgment upon the merits of such works as are subject to the rules of æsthetics. Under such circumstances, just decisions regarding works of ornamental art and matters of taste cannot be expected; and it is thus we every day see the principles of design openly violated, not only with impunity, but frequently with encouragement. Nor can it be expected that the public should endeavour to acquire a knowledge of laws which many of those who profess to follow high art seem to disregard.

Attention to the elementary principles of harmonious colour in the decoration of our ordinary dwellings, in such of our manufactures as admit of it, and even in our dress, will, in some measure, assist in diffusing one kind of knowledge of what constitutes visible beauty, and the more effectually that, in our climate, we are, for a considerable portion of the year, compelled to dispense with the gratification and instruction which external nature affords the eye, and, in the absence of works of high art, to content ourselves with that which the interior decoration of our dwellings present.

ON THE

ANALOGY OF THE HARMONY OF COLOUR.

In a former Treatise on Colour, I confined this part of the subject to an attempt to point out the analogy that exists between the harmony of colour and that of sound; and I did so from an idea, that in this country a knowledge of the first principles of the science of music, bore some proportion to the extent to which that art is taught and practised, and that, in consequence, I should more readily lead to an understanding of the one species of harmony by comparing it to the other. But I am now convinced that this was a mistaken idea, and that, instead of a knowledge of the first principles of harmony being general, it is so limited, that but few of the professors of painting, sculpture, or architecture, to whom they ought to be familiar, have paid any attention to the subject. Even among teachers of music, there are few who are sufficiently acquainted with the philosophy of their art. This is much to be regretted, for the general principles of harmony are

uniform throughout the whole science of æsthetics, and, as in no department of that science have their effects been more clearly developed than in music, there can be no better method of pointing out their peculiar nature, than by reference to the first principles of that art. I shall therefore still refer to it, and in doing so, show that the harmony addressed to the eye, like that addressed to the ear, is of an exclusively mathematical nature.

In an attempt to define æsthetical taste, which, in the form of a short Essay, accompanied the fifth edition of "The Laws of Harmonious Colouring adapted to Interior Decorations," I have shown that there appears to be implanted in the human mind a governing principle of harmony of a mathematical nature, responsive to impressions made upon the organs of sense by certain combinations, motions, and affinities in the elements of matter. Of this nature are the effects produced upon the mind by sensations received through the eye from colours and forms, as also those received through the ear from sounds.

These combinations, motions, and affinities, act by the harmony of numbers, exemplified in the agreement of certain arithmetical ratios. To those acquainted with the science of acoustics, this is known to be the case in regard to the affinities which musical notes bear to one another, and which are the cause of harmony when two or more are simultaneously produced. These consonances are agreeable to the ear, according to the degree of numerical simplicity

which the notes bear to one another in the rapidity of the vibrations which produce them, the affinity becoming less and less as the complexity in this ratio increases. Upon this the foundation of musical harmony rests, and its principles being acknowledged as laws of nature, we are assured that its beauty has a real existence, independently of any opinion, fancy, whim, or association of ideas in the mind, to which it is, through the organs of sense, addressed. Upon such first principles are also based the harmony and beauty of colours and forms, and it is in the operation of these principles that the true analogy exists.—(Note A.)

It would, therefore, appear that the only means by which a proper understanding can be arrived at of what constitutes any kind of visible beauty, appreciable by the human mind, is a development of the operations of those mathematical laws in the combinations of visible matter.

The harmony of sound arises naturally from numerical ratio in the following manner:—A musical note produced by the agitation of a vibratory body, is uniformly accompanied by other two, bearing to it in the rapidity of the pulsations from which they arise, the proportional ratios of 2 to 1, and 3 to 1. This is the fundamental principle of the natural scale of musical notes, and of all successive and combined harmony. The note produced may be acute or grave, but whatever be the degree of rapidity in the undulations of the atmosphere that act upon the organ of hearing in producing the sensation of that particular sound, the

undulations of the other two notes that accompany or immediately succeed it are always in these ratios; hence they are called harmonics. When the original note is powerful, these two first harmonics are succeeded by others in a gradual descent from the original simplicity of ratio down to those of a more complex kind, the affinity to the first note as gradually decreasing.

The appearance of those apparitions called the accidental or compensatory colours is in perfect accordance with this phenomenon, for they always accompany or immediately follow any sensation produced by the impression from an individual colour upon the optic nerve; and these spectra are always at first in power to the original colour in the ratio of 1 to 2, and are always such as make up the harmonic triad, with the colour by which the impression is made.—(Note B.)

When two notes are produced causing the same number of atmospheric undulations in a given portion of time, they are then in perfect consonance or unison as to their pitch or place in the scale, however much the nature of the materials by which the undulations are caused may differ. In the same manner do widely differing materials exhibit to the eye colours of precisely the same nature, and consequently belonging to the same place in the colorific series.

Notes that thus assimilate are, therefore, to one another in their undulations in the simple ratio of 1 to 1, and their effects upon the ear are exactly the same. So are the

powers of any two colours that match each other in the nature of their effect upon the eye, and their relation either to light or to darkness, however much the substances so coloured may differ in other respects.

The harmonic ratios, therefore, commence with those of 1 to 1, 1 to 2, and 1 to 3; and it is known as a fact in acoustics, that all the melody and harmony of which the human ear is susceptible, or the mind is perceptive, thus originates in the operation of the numbers 1, 2, 3, in affecting the affinities of quantity and motion of matter. These numbers, it will be shown, are equally potent in regulating the harmony of colours, and operate, in the first place, upon the active and passive principles of light and darkness, in producing the primary elements of all chromatic beauty—red, yellow, and blue. The active principle of light being in yellow as 3, and the passive principle of darkness as 1; in red, these two principles mutually operate; and in blue, the active principle operates as 1, and the passive as 3, as shall be afterwards more fully explained.

So also do these ratios exist in the primary elements of form, as in the case of the solid quantities contained in cones, spheres, and cylinders, which, when of the same base and altitude, whatever their size may be, bear the constant ratio of 1, 2, 3. The three primary plane figures—the circle, the rectangle, and the triangle, are sections of these solid bodies, and consequently have proportional quantities of superficies and perimeter to each other.

The analogy is likewise perfect as to the number of primary and secondary elements of which their respective scales are composed. In music, the notes are seven, and are named do, re, mi, fa, sol, la, si, of which the tonic do, the medient mi, and the dominant sol, may be reckoned the primaries. In form, the characteristic plane figures are seven—the circle, the oblong, the triangle, the rhomb, the rectangle, the ellipse, and the polygon, of which the circle, rectangle, and triangle are the primaries. In colour, also, the scale is made up of seven parts—red, orange, yellow, green, blue, purple, and gray, of which, as already stated, red, yellow, and blue are the primaries. Out of these elements arise all the physical beauty which the understanding is capable of appreciating through the eye and the ear; and the degree and nature of this beauty will always depend upon the mode in which the harmonic ratios operate, either in the combination, motion, or affinities of matter.

In the natural affinities of the parts of which these scales are composed, the harmony of numbers operates by combination and division as follow. The first primary combination of the unit gives its multiple 2, which is a sub-multiple of the numbers 4, 6, 8, progressively, as 2, 3, 4; and it is the first even number. The number three is also simply a multiple of the unit, and is the first tertiary combination or odd number; it is a sub-multiple of 6, 9, 12, &c. progressively, as 2, 3, 4, and is at the same time a compound of 1 and 2 added together. The next multiple of 1, having no other

aliquot parts, is 5, a compound of the first even and first odd numbers 2 and 3 ; it is a sub-multiple of 10, 15, 20, &c.

These three numbers are therefore the first three multiples of 1 that are multiples of no other number, and upon the proper operation of these numbers depends the harmony which constitutes beauty.

The primary or leading harmonic ratios produced by the operation of those numbers upon quantities, motions, or powers of matter, are 1 to 2, 2 to 3, 4 to 5, and these are called in the natural scale of music, the consonances of the tonic and its octave, the tonic and its fifth or dominant, and the tonic and its third or medient. The other parts of the scale are, in this respect as 3 to 4, 3 to 5, 8 to 9, and 8 to 15, but no new mode of combination is here presented—4, 8, 9, and 15, being multiples of 2, 3, and 5.

These are the elements of the natural scale of consonances and dissonances, for 8 to 9 and 8 to 15, are of the latter character, while there are two combinations not in this scale, namely 5 to 6, and 5 to 8, which are of the first character, but belong to the minor mode, and these complete the series of perfect consonances. In a former work, I gave these ratios in greater detail, and as the highest example in nature, pointed out their existence in the proportions of the human body, and, as the best evidence of their application in art, a close adherence to them in the proportions of the portico of the Parthenon.—(Note C.)

It seems, however, that it is not in æsthetical science alone that this mathematical principle operates. A philosophical writer, in a late number of a medical work,* observes :—" There is harmony of numbers in all nature—in the force of gravity—in the planetary movements—in the laws of heat, light, electricity, and chemical affinity—in the forms of animals and plants—in the perceptions of the mind. The direction, indeed, of modern natural and physical science is towards a generalization, which shall express the fundamental laws of all by one simple numerical ratio. We think modern science will soon show that the mysticism of Pythagoras was mystical only to the unlettered, and that it was a system of philosophy founded on the then existing mathematics, which latter seem to have comprised more of the philosophy of numbers than our present."

Before showing the mode in which the harmony of numbers operates in combinations of colours, however, it will be requisite to inquire into the phenomenon of their production, and the relations they bear to one another.

* British and Foreign Medical Review, No. xxxv. p. 171.

ON THE

NATURE AND RELATION OF COLOURS.

LIGHT may be considered an active, and darkness a passive principle, in the economy of Nature, and colour an intermediate phenomenon arising from their joint influence, It is usual to consider colour as an inherent quality in light, and to suppose that every coloured body absorbs a certain class of its rays, and reflects or transmits the remainder; but it appears to me, that colour is more probably the result of certain modes in which the opposite principles of motion and rest, or force and resistance, operate in the production and modification of light, and that each colour is mutually related to these active and passive principles. In the three colours, yellow, red, and blue, now universally acknowledged as the primary elements of chromatic beauty, these principles seem to operate in progressive ratios, for, if the purest powdered pigments be mixed in the proportion of 1 yellow, 2 red, and 3 blue, a cool-toned gray is the

result, resembling a mixture of black and white: if the mixture be changed to 1 blue, 2 red, and 3 yellow, we have a warm-toned brown; but the neutral gray in which light, shade, and colour are equally represented, is the result of a mixture of equal quantities.

White and black are the representatives of light and darkness, while yellow, red, and blue, are the primary elements of colour. From the union of these elements in certain proportions, every conceivable variety of colour and hue arises; but their nature and qualities in relation to light and shade, and to one another, must be well understood before proper modes of combination can be adopted. White and black, therefore, being only the representatives of light and darkness, cannot be reckoned colours, but merely their modifiers, in reducing them by their attenuating and subduing qualities to tints and shades respectively.

The relations that yellow, red, and blue, bear to light and darkness, and the mode in which those relations operate throughout the colorific circle, may be shown in the following manner:—Let us suppose the active principle of light divided into 180 parts, and the passive principle of shade into the same number, so that the medial gray arising from their joint influence, will be to each of these principles or powers as 90, that is, in the ratio of 1 to 2, because they mutually neutralize each other; and the following are the proportions in which light and shade will be found to be combined in the primary elements of colour.

	Relation to Light.	Relation to Darkness.	Medial Power as a Colour.
Yellow, ...	45	15	30
Red, ...	30	30	30
Blue, ...	15	45	30
	—	—	—
Neutral Gray,			90

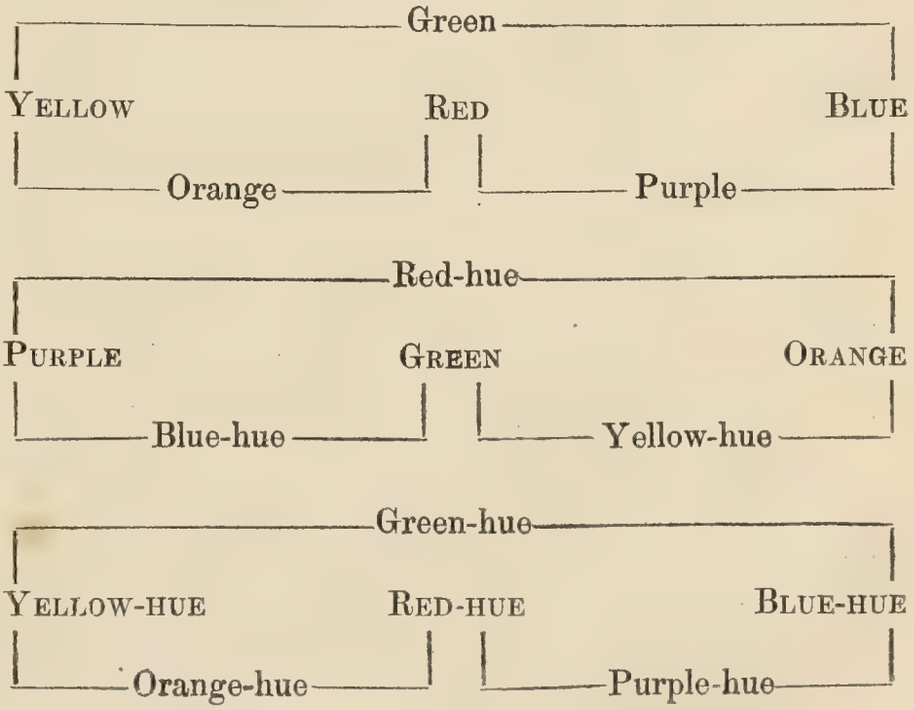
They may here, however, be reduced to their lowest denominations, as the higher are only useful in reducing colours to tints and shades.* These numbers are:—

	Light.	Darkness.	
Yellow, ...	3	1	2
Red, ...	2	2	2
Blue, ...	1	3	2
	—	—	—
Neutral Gray,			6

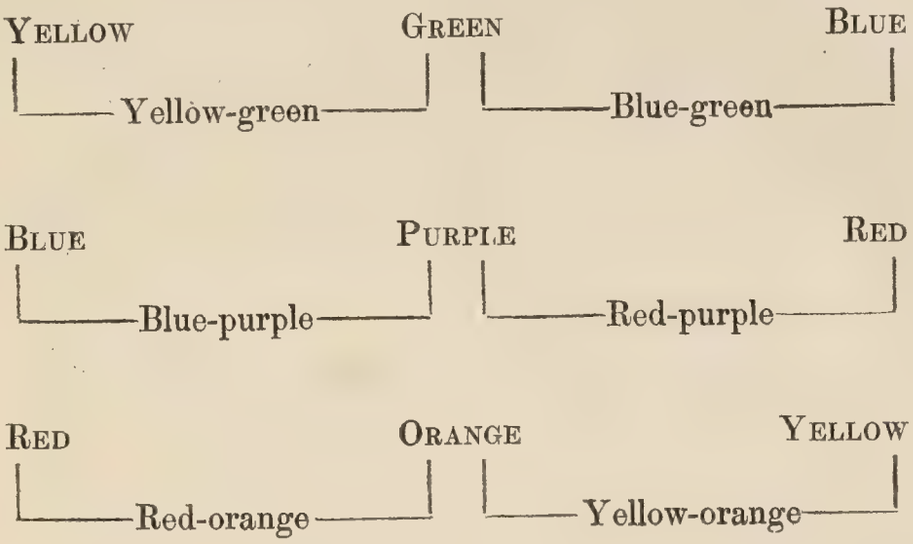
Red, it will be observed, is the most perfect colour, from its having an equal relation to light and shade, the two principles being exhibited in it in the same ratio as in neutral gray, but in a different and more vigorous mode. In yellow, the active principle being to the passive as 3 to 1, and in blue, as 1 to 3, these colours when united in green, exhibit the two principles acting, as in red, in equal ratios; thus constituting green the most perfect of compounded

* In my "Nomenclature of Colours," &c. the higher denominations are retained for this purpose.

colours. The secondary colours are, orange, green, and purple, and are produced by the pairing of the primaries. In the hues, the three primary colours are combined, and these combinations are of two classes—primary and secondary. The primary class arise from pairing the secondary colours, and are generally called citrine, russet, and olive, but, for the sake of perspicuity, I shall name them after the primaries to which they belong. From the pairing of these primary hues, the semi-neutrals, or secondary class of hues, are produced. These various modes of union are shown in the following diagrams :—



The secondary colours may have an excess of either of the two primaries of which they are severally composed, and their tone thus be altered in various degrees.



These modifications of the secondary colours are shown in Example IV. From the binary union of these modified secondaries, no farther variety of hue arises than the predominance or subordination of one or other of the primaries in proportions similar to what arise from ternary modes of union to be afterwards explained.

The following may be taken as the relative quantities of the primary elements in these three classes of compound colours :—

Orange.		Green.		Purple.
Yellow, 2	.....	Yellow, 2	.....	Blue, 2
Red, 2	.....	Blue, 2	.....	Red, 2

Blue-hue.		Red-hue.		Yellow-hue.
Yellow, 2	.....	Yellow, 2	.....	Yellow, 4
Red, 2	.....	Red, 4	.....	Red, 2
Blue, 4	.....	Blue, 2	.....	Blue, 2

Orange-hue.		Green-hue.		Purple-hue.
Yellow, 6	.....	Yellow, 6	.....	Yellow, 4
Red, 6	.....	Red, 4	.....	Red, 6
Blue, 4	.....	Blue, 6	.....	Blue, 6

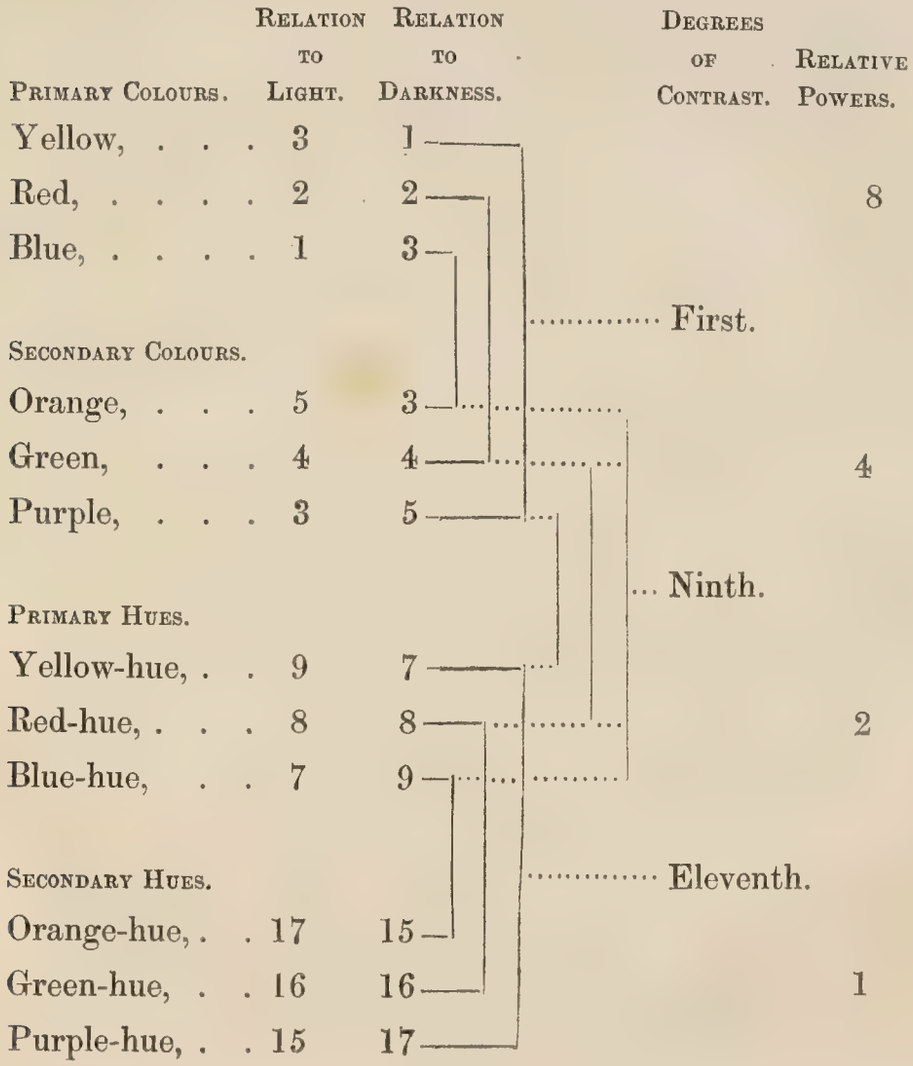
From these quantities, it will be seen, that the hues owe their distinction exclusively to the proportionate predominance of one of the primary colours in each of the first class, and a like subordination of one of these in each of the second. This rule holds good throughout every species of colouring in nature and art.

The primary elements are in the modified secondaries as follow:—

Yellow-orange.		Yellow-green.		Red-orange.
Yellow, 4	.....	Yellow, 4	.....	Yellow, 2
Red, 2	.....	Blue 2	.....	Red, 4

Blue-purple.		Red-purple.		Blue-green.
Blue, 4	.....	Blue, 2	.....	Blue, 4
Red, 2	.....	Red, 4	.....	Yellow, 2

The relations and powers of the three classes of colours, as they naturally arise out of the binary mode of union, are shown in the following table :—



The powers of the colours and hues in the foregoing table, it will be observed, are in an inverse ratio to the quantities which express their mode of combination, but as each successive mode is a step towards neutralization, these quantities express the rate of their approach to that negative quality.

The contrasts shown in this table are, so far as I know, all that have ever been exhibited in any work on the subject hitherto published; but the situations which I find they occupy, namely, the 1st, 9th, and 11th in the scale, which I am about to lay before the reader, proves the necessity that exists for some more extended and practical system of harmony.

In this attempt to explain the nature and relations of colours, it will be observed that I have adopted red, yellow, and blue, as the primary elements; but at the time my first essay on this subject was published, there were seven such elements recognised in the scientific theory of colours. In the essay alluded to, I gave a short account of the origin of this theory, and also stated my reasons for adopting another, both of which I shall here repeat.

"The scientific theory of colour was established by Sir Isaac Newton in the following manner.—

"In the window-shutter of a darkened room he made a hole of about the third of an inch in diameter, behind which, at a short distance, he placed a prism, so that a ray of the sun's light might enter, and leave it at equal angles. This

ray, which before the introduction of the prism proceeded in a straight line, and formed a round spot upon a screen placed a few feet distant from the window, was now found to be refracted, of an oblong form, and to be composed of seven different colours of the greatest brilliancy, imperceptibly blended together, viz. violet, indigo, blue, green, yellow, orange, and red. This is called the solar or prismatic spectrum.

" The theory established by this experiment was, that the white light of the sun is composed of several colours, which often appear by themselves, and that this white light can be separated into its elements.—(Note D.)

" By making a hole in the screen upon which the spectrum is formed, opposite to each of these colours successively, so as to allow it alone to pass, and by letting the colour thus separated fall upon a second prism, Sir Isaac found that the light of each of the colours was alike refrangible, because the second prism could not separate it into an oblong image, nor alter its colour; hence, he called all the colours simple or homogeneous.

" I had long known practically that four of these seven colours could be produced by combining the other three, red, yellow, and blue, in pairs, and that writers on the art of painting always treated those three colours as the only simple elements of chromatics, and all others as compounds.

" Thus the scientific theory of the natural philosopher in treating of the transient colours in the phenomena of nature,

differed from that of the practical artist, in treating of the inherent colours of his pigments.

" I hesitated long which of the two to adopt; the first was established by the experimental inquiries of the greatest natural philosopher of the age in which he lived—while the other, if a theory it could be called, was simply an understanding resulting from practice.

" Yet this latter appeared to me more consistent with the general simplicity of nature, and I could not believe that she required seven homogeneous parts to produce what art could do by three. For instance, an artist can make all the colours, and indeed a correct representation of the prismatic spectrum (so far as the purity of his materials will allow), with three colours only; while, according to the theory of Sir Isaac Newton, seven simple or homogeneous colours were employed to produce the real one.

" The following discovery, made by Buffon, and illustrated by succeeding philosophers, helped to strengthen me in the conviction that the scientific theory might, like that of the practical artist, be reducible to three simple or homogeneous parts. If we look steadily for a considerable time upon a spot of any given colour, placed on a white or black ground, it will appear surrounded by a border of another colour. And this colour will uniformly be found to be that which makes up the triad; for if the spot be red, the border will be green, which is composed of blue and yellow; if blue, the border will be orange, composed of yellow and red; and

if yellow, the border will be purple, making in all cases a triunity of the primary colours.

" With a view to throw such light upon the subject as my limited opportunities would permit, I tried over the experiments by which Sir Isaac Newton established his theory, and the same results occurred: I could not separate any one colour of the solar spectrum into two. The imperceptible manner in which the colours were blended together upon the spectrum, however, and the circumstance of the colours which practical people called compound, being always placed at the adjunct of the two of which they understand it to be composed, with my previous conviction, induced me to continue my experiments; and although I could not, by analysis, prove that there were only three colours, I succeeded in proving it to my own satisfaction, synthetically, in the following manner:—

" After having tried every colour in succession, and finding that none of them could be separated into two, I next made a hole in the first screen, in the centre of the blue of the spectrum, and another in that of the red. I had thereby a spot of each of these colours upon a second screen. I then, by means of another prism, directed the blue spot to the same part of the second screen on which the red appeared, where they united and produced a violet as pure and intense as that upon the spectrum, I did the same with the blue and yellow, and produced the prismatic green; as also with the red and yellow, and orange was the result.

I tried, in the same manner, to mix a simple with what I thought a compound colour, but they did not unite; for no sooner was the red spot thrown upon the green than the former disappeared.

"I tried the same experiment with two spectrums, the one behind, and of course a little above the other, and passed a spot of each colour successively over the spectrum which was farthest from the window, and the same result followed. It therefore appeared to me that these three colours had an affinity to one another that did not exist in the others, and that they could not be the same in every respect, as had hitherto been taught, excepting as to colour and refrangibility."—*Laws of Harmonious Colouring, 5th edition.*

These opinions I published in 1828, and I did so with great diffidence, fearing that my temerity might be deemed presumption, but I had, subsequently, the gratification of learning that the facts I had advanced were afterwards proved in a communication read to the Royal Society of Edinburgh by Sir David Brewster, on the 21st of March 1831, in which he showed that white light* consists of the three primary colours, red, yellow, and blue; and that the other colours shown by the prism are produced by a mixture of these.

I therefore now confidently adopt the theory which acknowledges three primary homogeneous colours only.

* See Note D.

ON

CONTRAST OR OPPOSITION OF COLOURS.

After becoming acquainted with the nature, relations, and analogy of colour, the next step towards a perfect knowledge of what constitutes its harmony, is to obtain a clear understanding of contrast or opposition, for upon this depends the character and beauty of every composition.

Eastlake, in one of those valuable notes which accompany his translation of Goethe's Theory of Colours, observes, that it is a fault in the examples accompanying all treatises on colour hitherto published, that they do not convey a proper idea of the contrasts upon which depends harmonious effects in painting, because the colours brought into contact are always of equal intensity, and differ only in the abstract quality of colour.

It certainly is true, that examples confined to the elements of the colorific circle, convey but a very crude idea of the nature of harmonious combinations, the beauty of

which, as this distinguished artist has shown in his works, as well as his writings, consisting in their more subtile and refined modifications. Such simple examples are, however, the first steps towards a knowledge of the nature and relative powers of the scale of colours, and are consequently useful, so far as they go, in forming initiatory lessons.

The three primary colours, out of the combination and modification of which all chromatic harmony arises, are, as already stated, yellow, red, and blue, and the result of their first mode of combination is shown on Example I.

In this example three important principles are evolved in the opposition of colours, by one of which the character of each of the contrasts is distinguished. The first is that of abstract colour exhibited in red and green; the second is the enhancement in power given to colorific opposition by the light and shade which enter into the elements of colour, apparent in the contrast of yellow and purple; and the third is coolness and warmth of tone, fully exemplified in the contrast of blue and orange. These primary contrasts are shown on this example in figures 1 and 4, 2 and 5, and 3 and 6. The first is the most perfect and pleasing, because these various principles are equally balanced, and it is characteristic of gaiety and cheerfulness; the second is the most sombre, and is characteristic of dignity and grandeur; while the third is the most positive and powerful, even approaching in this respect to harshness. These qualities prevail throughout all the various degrees and

modifications of which the contrasts alluded to are individually susceptible, as shall be shown in the sequel. Such are the most important lessons in harmony which the diagram of the six positive colours can give.

The second species of contrast that arises from the binary mode of union, is the opposition of the secondary colours to the primary hues. It is consequently of a much more modified and subdued kind than the first, because in it the secondary colours predominate, and the primaries are held in a low degree of subordination. See Example II.

The third species of contrast arising from the continuance of the binary mode of union, is that of the primary and secondary hues. This species is of a still more subdued character, but it is only a modified repetition of the first. See Example III. See also the Table page 23.

These examples, it has already been observed, show very wide intervals of harmony, and consequently stop far short of those more subtile and refined modes of contrast, upon which the beauty of colorific harmony so much depends. I shall therefore attempt, on the present occasion, to form intermediate harmonies of contrast, and shall endeavour to show that between any primary and secondary colour, a series of sixteen systematised and specific varieties may be established, and this by the modification of the three primary colours alone, without the assistance of more light and shade than what has been shown to belong to them inherently.

ON CONTRAST OR OPPOSITION OF COLOURS.

Although the beauty of colour depends upon contrast, yet it does not consist solely in those oppositions that are most intense and powerful, such as shown in Example I., or even in those that are most perfect in their elements, as shown in Examples II. and III., but requires the assistance of those modifications by which a prominence and an enhancement is given to one colour by a well graduated subordination of every other with which it is associated. This value may be given, in any composition, either to a primary or to a secondary colour, whether exhibited in a pure state, or merely predominating in a hue, and as every hue owes its specific nature to the predominance or subordination of one of these primary colours, all contrasts refer to one of the three elements, either as being plus or minus in the harmony produced, that is, in either forming the subject or the accompaniment.

At the risk of repetition, I shall here give a more precise definition of what I have before advanced on this important part of the subject.

By the union of two simple colours we alter the nature of both, and have a compound colour; and as there are only three simple colours in the scale, the two that are thus united, form the natural contrast to the remaining simple colour. When, therefore, we wish to reduce the intensity of a simple colour, we must do so by mixing with it a certain portion of the colour produced by the union of the other two primaries, and the simple colour thus reduced

retains, to a certain extent, its nature and characteristic qualities, until the compound colour assumes the character of a primary hue, which it does when the ratio of the compound to the simple colour is equal; every farther addition of the compound colour reduces the hue, until the ratio of the compound be to the simple colour as 2 to 1, when neutralization of both takes place. Hence all the hues in which a primary or simple colour predominates above an equal ratio, are tones of that primary colour, and when below it, are tones of a primary hue. When, on the other hand, we wish to reduce the intensity of a binary compound or secondary colour, we must do so by mixing with it a certain portion of the simple colour to which it forms the natural contrast, and the secondary colour thus reduced will retain its characteristic qualities, until the primary or simple colour bear the ratio to the compound colour of 1 to 4, at which point the secondary hue is produced; neutralization of both taking place at that of 2 to 4. Hence all the hues in which one of the primary colours is subordinate to the other two, are tones of the compound colour, which these two simple colours would produce by their union. In either case, if the addition of the subduing colour be continued beyond the ratio that produces neutrality, the hue becomes a tone of the colour so added. It follows that in every hue of *red*, yellow and blue are subordinate—in every hue of *yellow*, red and blue are subordinate—and in every hue of *blue*, red and yellow are subordinate. In like man-

ner, in every hue of *green*, red is subordinate—in every hue of *orange*, blue is subordinate—and in every hue of *purple*, yellow is subordinate. The secondary hues, as formerly stated, therefore owe their character to the subordination of one of the primary colours.

As all the variety that extends beyond the six positive colours is thus simply constituted, it may be said that there are only three proper contrasts of colour in nature, and that all others are only modifications of these. Pure red is the most intense and perfect contrasting colour to green, because neither blue nor yellow exist in its composition; and, on the other hand, pure green is the most perfect contrast to red, because it is composed of yellow and blue only. When any two of the three primary colours are united together in a secondary colour, they are mutually deprived by neutralization of one half of their power, therefore, in the contrast of red and green, red is plus, and is in power to the green as 2 to 1. But when pure green is opposed to red-hue, the red is minus, and green becomes the characteristic colour of the contrast, because the yellow and blue by which the red is neutralized to a hue are the constituents of green, and consequently give it a species of predominance over the red. Such is the simple nature of contrast, upon which chromatic harmony solely depends.

DEVELOPMENT OF A NEW SYSTEM OF CHROMATIC HARMONY.

I shall now proceed to systematise and extend these principles to the more modified and useful varieties of harmony; and, in doing so, I shall endeavour to adhere closely to the method which nature seems to point out in the origin of the elementary colours by the union of light and shade.

As just explained, all modifications of the elementary contrasts must be produced by the action of a primary upon a secondary colour, or *vice versa*. A primary being to a secondary colour in power as 2 to 1, and to a secondary hue as 4 to 1, my first attempt to extend the scale of Chromatic Harmony, was to compound a secondary hue, to which a primary colour would be in the ratio of 3 to 1; and finding that the relative power of contrast between a primary hue and secondary colour was in the ratio of 4 to 3, I compounded a hue having the next degree of harmonic ratio to the primary hue, namely, 5 to 3, and the result is given in Examples V., VI., VII. In the first of these examples, the hues thus produced (to which I shall give the name of tempered colours) are placed in contrast with one another. In the second, the primary colours are opposed to the tem-

pered secondaries, and in the third, the secondary colours are opposed to the tempered primaries. This last is one of the most beautiful species of contrast, and its parts are to one another in the ratio of 3 to 2, as shall presently be shown. On the beauty arising from this extended application of the harmonic ratios to colour it is needless to insist, as the examples just referred to, it is presumed, will give satisfactory evidence on that point.

Seeing that on the other side of the primary and secondary hues, there existed an equally wide interval towards neutrality as towards colour in the opposite direction, I have filled it up in a similar manner by two tempered hues, the primary colour being in power to the tempered secondary hue in the ratio of 5 to 1, and the secondary colour being to the tempered primary hue in that of 5 to 4. These four specific hues added to the primary, secondary, tertiary, and semi-neutral colours (as the primary and secondary hues are generally termed), complete my scale.

I shall take red and green to exemplify the mode in which the degrees of this scale are compounded; but it should be understood, at the same time, that a similar scale may be formed from yellow and purple, or blue and orange, upon precisely the same principle. For reference to the coloured examples, I have distinguished the degrees by the first eight letters of the alphabet.

A primary being to a secondary in power as 2 to 1, I shall consider the former as consisting of four parts, and the lat-

ter of eight, or double in quantity; and upon this principle the following scale is formed.—

Scale of Chromatic Harmony exemplified by the mixture of Red and Green.

Degrees.		Colours and Hues.	Composed of		Ratio of Neutralizing Powers of the two Colours in each Hue.		
					Red.		Green.
1*st*,	A,	Red.——					
2*d*,	B,	Tempered Red, .	Red, 4 Green, 2		4	to	1
3*d*,	C,	Red-hue,	Red, 4 Green, 4		4	~	2
4*th*,	D,	Tempered Red-hue,	Red, 4 Green, 6		4	~	3
5*th*,	E,	Tempered Green-hue,	Red, 3 Green, 8		3	~	4
6*th*,	F,	Green-hue,	Red, 2 Green, 8		2	~	4
7*th*,	G,	Tempered Green, .	Red, 1 Green, 8		1	~	4
8*th*,	H,	Green.——					

The hues thus constituted between red and green are given in Example VIII.; and the four Diagrams that here follow, show how the sixteen varieties of contrast are produced between these colours.

Diagram of the first four Contrasts between Red and Green.

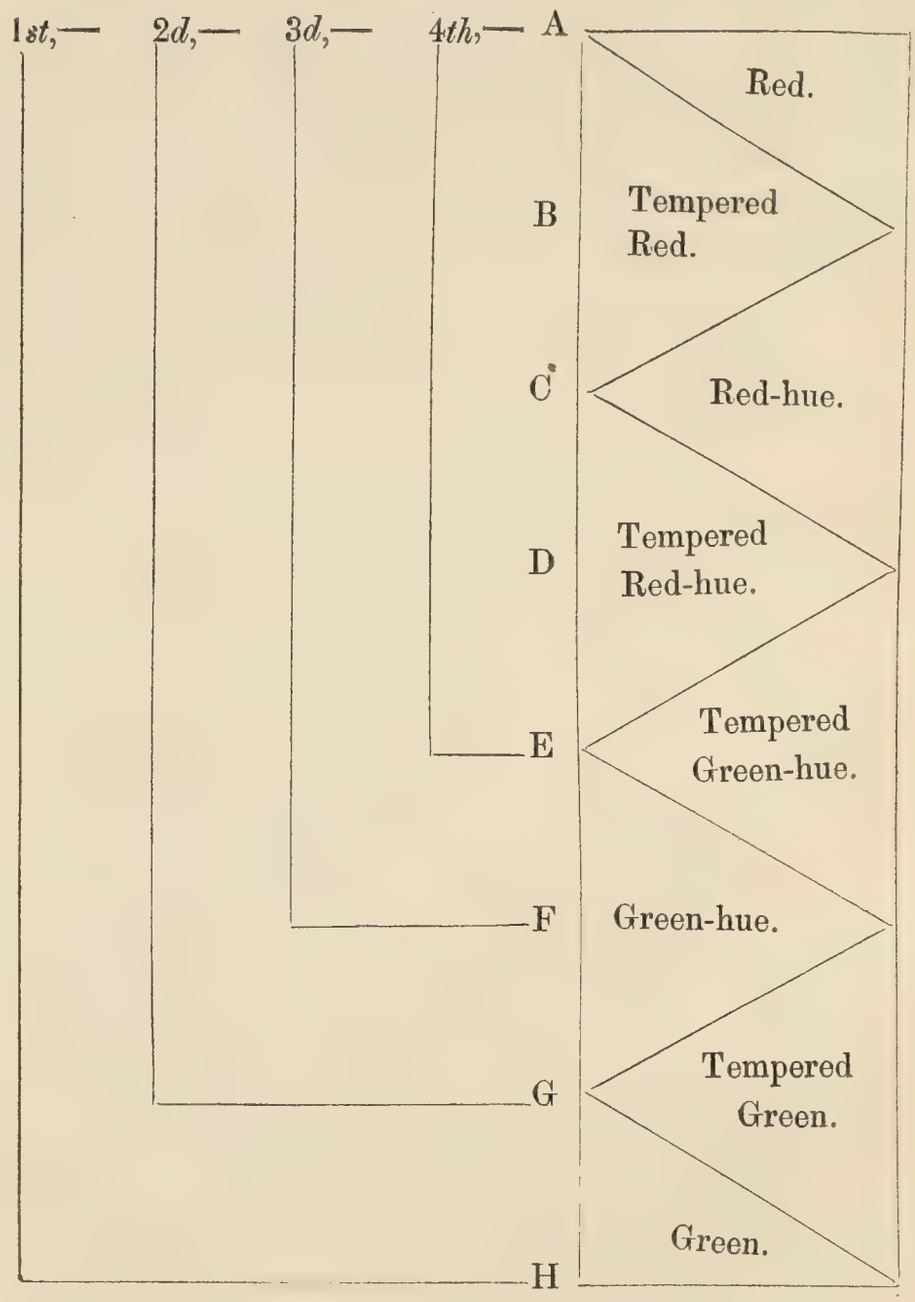


Diagram of the Second Four Contrasts between Red and Green.

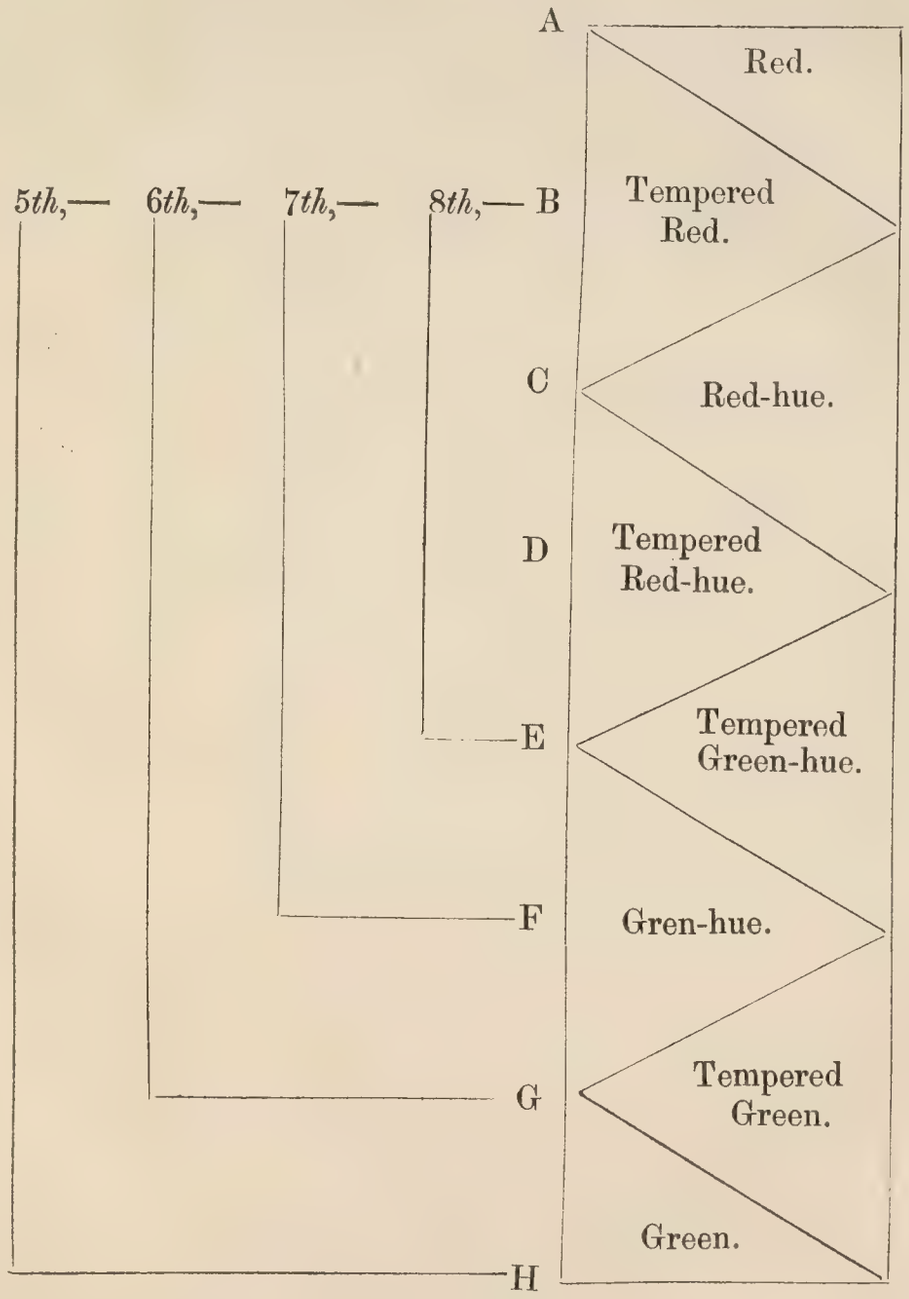


Diagram of the Third Four Contrasts between Red and Green.

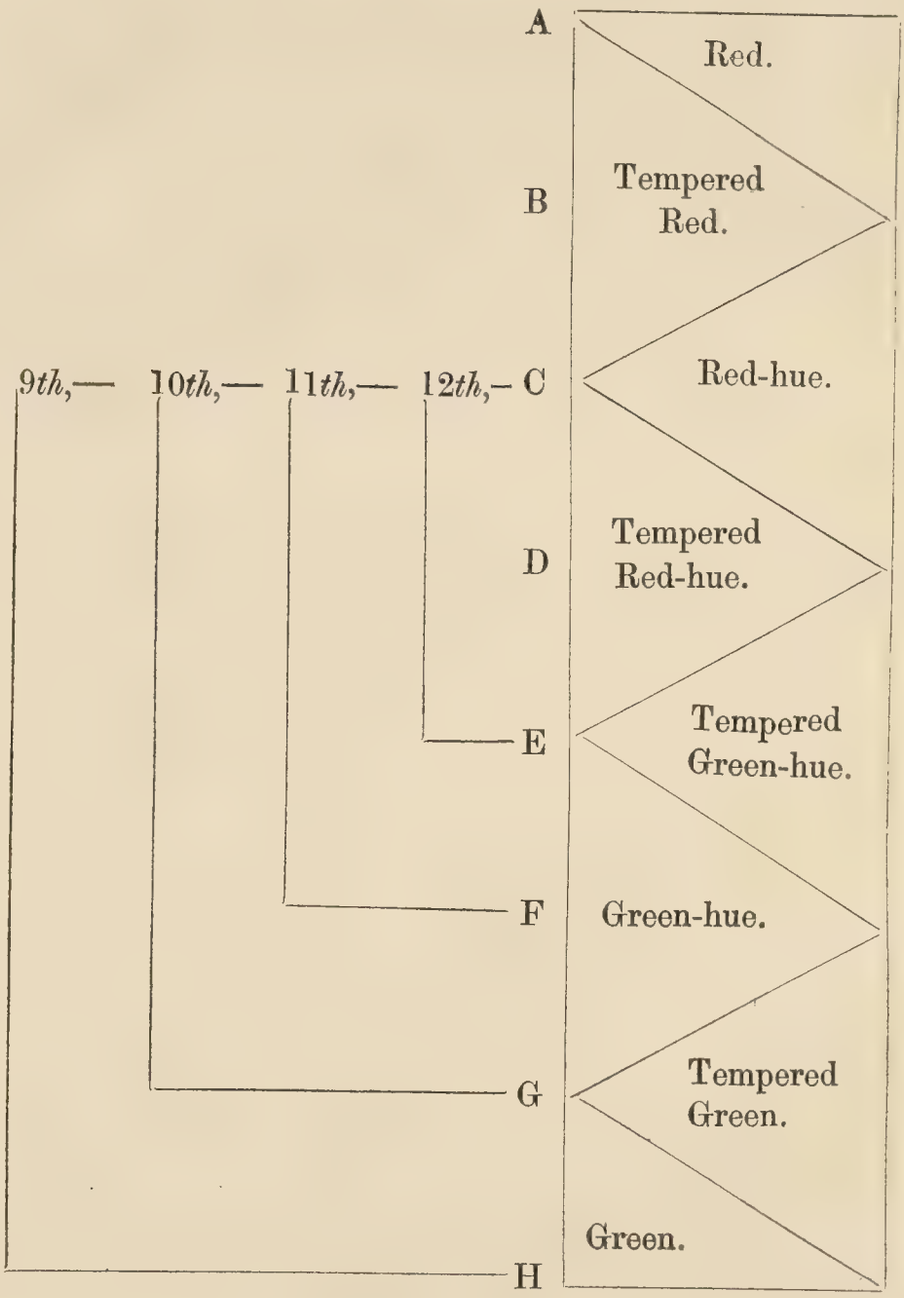
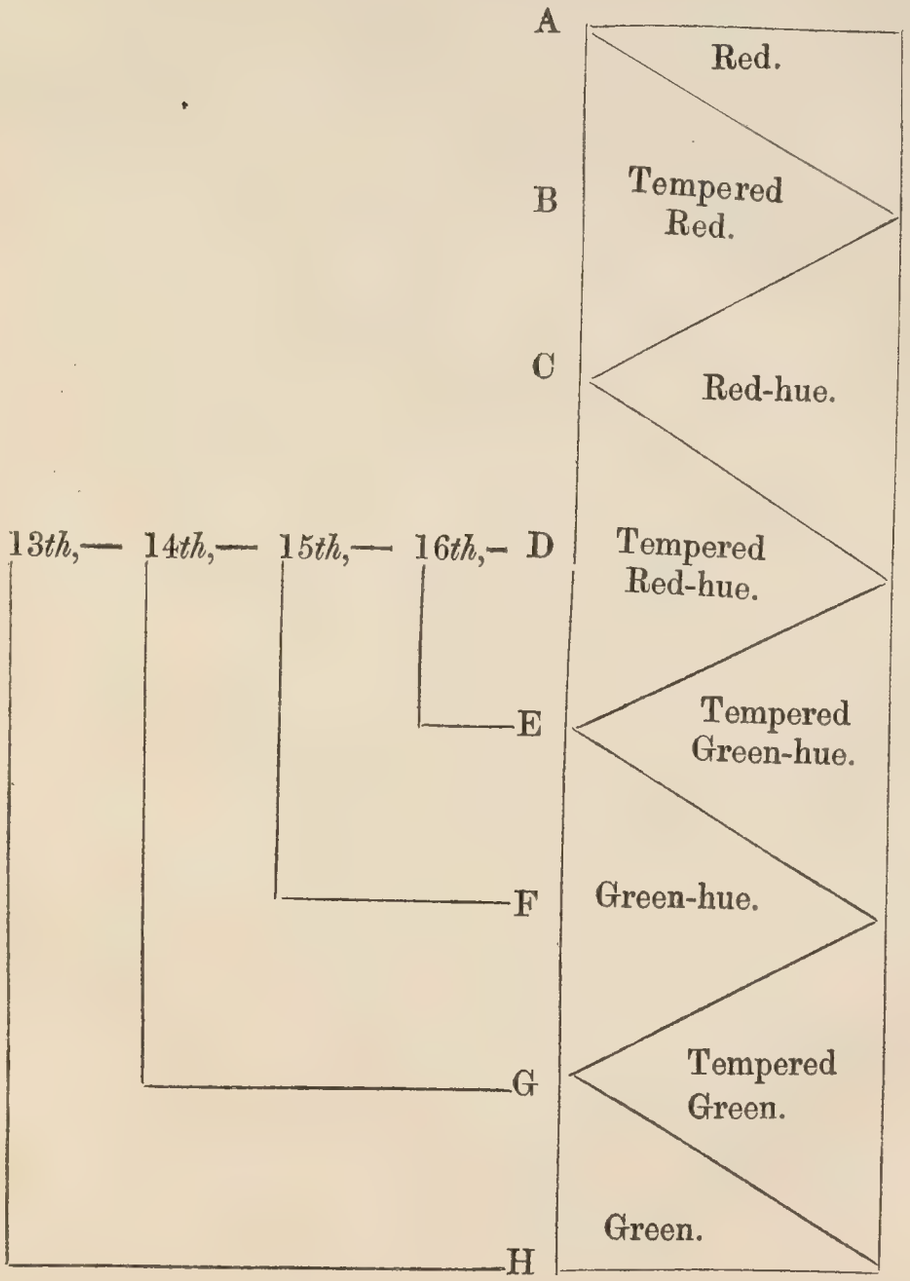


Diagram of the Fourth Four Contrasts between Red and Green.



F

The Scale of Harmony exhibited in the foregoing Diagrams of Contrast.

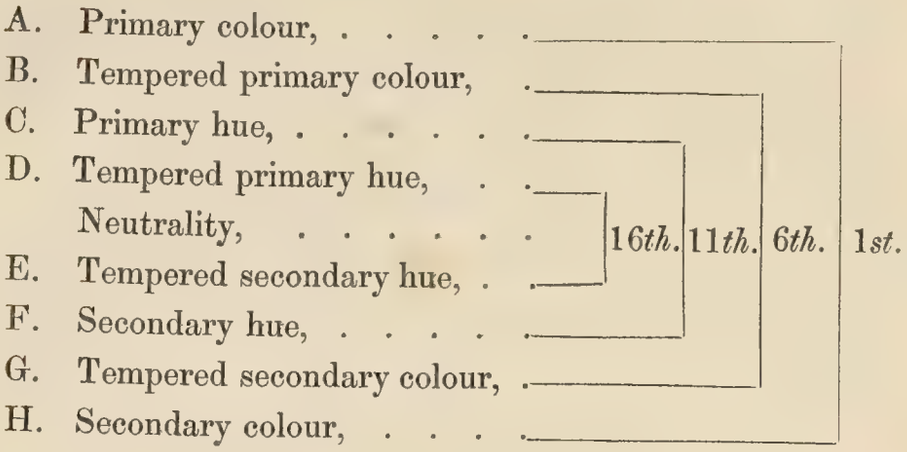
Degrees of Scale.	Letters on Scale.	Names of Colours and Hues.	Harmonic Ratios.
1*st*,	A and H,	Primary colour to Secondary colour, ...	2 to 1
2*d*,	A ... G,	Primary colour to tempered Secondary colour, ...	3 ~ 1
3*d*,	A ... F,	Primary colour to Secondary hue, ...	4 ~ 1
4*th*,	A ... E,	Primary colour to tempered Secondary hue, ...	5 ~ 1
5*th*,	B ... H,	Tempered Primary colour to Secondary colour, ...	3 ~ 2
6*th*,	B ... G,	Tempered primary colour to tempered Secondary colour, .	4 ~ 2
7*th*,	B ... F,	Tempered primary colour to Secondary hue, ...	5 ~ 2
8*th*,	B ... E,	Tempered primary colour to tempered Secondary hue, . .	6 ~ 2
9*th*,	C ... H,	Primary hue to Secondary colour, ...	4 ~ 3

Scale of Harmony—*continued.*

10*th*,	C and G,	Primary hue to tempered Secondary colour, ...	5 to 3
11*th*,	C ... F,	Primary hue to Secondary hue,	6 ~ 3
12*th*,	C ... E,	Primary hue to tempered Secondary hue, ...	7 ~ 3
13*th*,	D ... H,	Tempered primary hue to Secondary colour, ...	5 ~ 4
14*th*,	D ... G,	Tempered primary hue to tempered Secondary colour, .	6 ~ 4
15*th*,	D ... F,	Tempered primary hue to Secondary hue, ...	7 ~ 4
16*th*,	D ... E,	Tempered primary hue to tempered Secondary hue, . .	8 ~ 4

Amongst the contrasts exhibited in the four preceding diagrams, and explained in the above scale, there are three, namely, B and G, C and F, and D and E, which recede from the primary contrast of A and H by an equally graduated reduction of power, and thus form a regular and definite series of equal contrasts between any primary and secondary colour. In order to point out more clearly to the reader

these peculiar modes of harmony, I have arranged them in the following manner :—



The other contrasts pointed out upon the diagrams and included in the general scale, it will be seen, have different and specific chromatic or colorific consonances, according to the harmonic ratios of quantity and power between each two degrees of the scale that produce them, while the powers of these degrees themselves originate, by the operation of the same ratios, in the proportions of their ingredients.

It has been shown in the formation of the scale, exemplified by red and green (page 37.), that the colours are reduced by graduating their relative powers, so that these tempered colours and hues recede from the positive colours to which they belong towards neutralization by three stages. As they do so, they become gradually weaker

in their power of contrast to the colour by which they are neutralized, as exemplified in the first four contrasts in the general scale, in which the ratios become more and more remote. But the interval between a primary and secondary colour, 2 to 1 (A and H), is the most perfect or complete, because all the other consonances must be between those two numbers. The second is that in which a primary colour is subdued or neutralized, by being mixed with its contrasting secondary, in the ratio of 4 to 1, as shown in the scale of hues (P. 37), and then opposed to this secondary in a pure state, by which the next most perfect interval of harmony is produced—3 to 2 (B to H). The third consonance is that which exists between a primary reduced to a hue, by the admixture of its contrasting secondary, in the ratio of 2 to 1, which, being opposed to this secondary in a pure state, produces a contrast of the next most pleasing kind, these elements being in the ratio of 4 to 3 (C and H).

The third consonance arises from this same primary hue being opposed to a secondary colour, which has been tempered or subdued by the admixture of the primary colour in the ratio of 1 to 4 (see Scale of Hues, P. 37). The elements of this contrast are in the harmonic ratio of 5 to 3 (C to G).

The fourth consonance arises from a secondary colour in a pure state being opposed to its contrasting primary neutralized by the admixture of the same secondary, in the ratio of 3 to 4, the elements being as 5 to 4 (D and H).

By this explanation of the most prominent harmonies of contrast exhibited in the above series, the remainder may be easily understood and applied in practice.

Besides the series of contrasting colours and hues, exemplified by red and green, and given in Example VIII. many of the contrasts described above occur in the other examples, and may be here pointed out, in order that the reader may examine and compare them, while engaged upon this part of the subject.

Red and Green.

1*st*,	A and H,	Example I.	figures 1 and 4
2*d*,	A ... G,	~~~ VI.	~~ 1 ... 4
	Also,	~~~ IX.	~~ 1 ... 4
5*th*,	H ... B,	~~~ VII.	~~ 1 ... 4
6*th*,	B ... G,	~~~ V.	~~ 1 ... 4
7*th*,	B ... F,	~~~ IX.	~~ 2 ... 3
9*th*,	H ... C,	~~~ II.	~~ 1 ... 4
	Also,	~~~ X.	~~ 4 .. 1
11*th*,	C ... F,	~~~ III.	~~ 1 ... 4
14*th*,	G ... D,	~~~ X.	~~ 2 ... 3

The hues that produce the 3d, 4th, 8th, 10th, 12th 13th, 15th, and 16th modes of contrast between these two colours, will be found in Example VIII., and the modes of contrast are described upon the four diagrams, Pp. 36, 37, 38, and 39. I may here remind the reader that the letters adopted to

stand for the colours and hues do not refer to red and green with their hues, exclusively, but also to yellow and purple, and to blue and orange with theirs.

Yellow and Purple.

1*st*,	A and H,	Example	I.	figures	2 and 5
2*d*,	A ... G,	〰	VI.	〰	2 ... 5
	Also,	〰	XI.	〰	1 ... 4
5*th*,	H ... B,	〰	VII.	〰	2 ... 5
6*th*,	B ... G,	〰	V.	〰	2 ... 5
7*th*,	B ... F,	〰	XI.	〰	2 ... 3
9*th*,	H ... C,	〰	II.	〰	2 ... 5
	Also,	〰	XII.	〰	4 ... 1
11*th*,	C ... F,	〰	III.	〰	2 ... 5
14*th*,	G ... D,	〰	XII.	〰	2 ... 3

Blue and Orange.

1*st*,	A and H,	Example	I.	figures	3 and 6
2*d*,	A ... G,	〰	VI.	〰	3 ... 6
	Also,	〰	XIII.	〰	1 ... 4
5*th*,	H ... B,	〰	VII.	〰	3 ... 6
6*th*,	B ... G,	〰	V.	〰	3 ... 6
7*th*,	B ... F,	〰	XIII.	〰	2 ... 3
9*th*,	H ... C,	〰	II.	〰	3 ... 6
	Also,	〰	XIV.	〰	4 ... 1
11*th*,	C ... F,	〰	III.	〰	3 ... 6
14*th*,	G ... D,	〰	XIV.	〰	2 ... 3

All the examples except VIII. being of the same figure, a perforated card or slip of paper, may be used to separate any of these contrasts from the others with which they are surrounded.

Before leaving this part of my subject, I may point out in what particulars the system here adopted, differs from any one hitherto published.

The secondary colours arising from the binary combination of the primaries, the primary hues from the binary combination of the secondary colours, and the secondary hues from the binary combination of the primary hues, have hitherto completed the scale. From the opposition of these to one another, only four kinds of contrast arose, producing the harmonies of 2 to 1, 4 to 1, 4 to 3, and 6 to 3. But here these wide intervals are filled up, and the systematic harmonies of contrast extended from four to sixteen. And it will be observed, that the intermediate kinds now, for the first time, systematized, are the most refined, and more closely resemble those which constitute the beauty of pictorial colouring.

The mode of the harmony of succession is easily deduced from that of the harmony of combination or contrast. The intervals that produce this harmony are called dissonances, two of which occur in the foregoing series at C to E, 7—3, and D to F 7—4; and as no two hues in which the same colour predominates can produce the harmony of contrast, the others will be found in A to D, A to C, A to B, corre-

sponding to 8 to 9, 9 to 10, and 8 to 15; and E to H, E to G, E to F, which, in like manner, may correspond to 7 to 8, 5 to 7, and 15 to 16.

This system, it will be observed, is applied to colours supposed to be in a state of pure intensity, and from these all the hues by which its harmony is regulated have been compounded. I have, at the same time, attempted to show that, even in this state of colorific purity, the primary colours are allied to darkness as well as to light; and in all their combinations with one another, exemplified in this Treatise, both principles have been understood to operate.

In a former part, page 17, it was stated, that the light embodied in the three primary colours collectively, is in power or quantity to white or pure light in the ratio of 1 to 2; it follows, that the shade embodied in them must be in the same ratio to black or perfect darkness, thus producing, when united, neutral gray. These two powers are, therefore, the constituents of, and are inherent in colour, and exist in the three primaries in the proportions explained at page 19. From these proportions full intensity of colour is supposed to result. But when more light is introduced into any colour or hue, such colour or hue becomes a tint, and when more darkness, a shade.

The number of tints between any colour or hue and pure light is almost infinite, as also the number of shades between any colour or hue and perfect darkness, because the colour is not altered, but simply attenuated or reduced like

the *diminuendo* in music. Yet this progression towards negation may be arrested at certain points, by which tints and shades may be individualised by specific divisions or intervals, such as Nature points out in the phenomenon of the production of colour itself. By such a mode of division, a series of tints from the three primary colours may be produced, capable of being subjected to the same process of harmonious combination here pointed out, with reference to intense colours. In like manner, various specific serieses of colours, deepened beyond the medial power of intensity here assigned them, might be systematically harmonised by a similar mode of combination.—(Note E.) I do not assume, however, that a perfect system of harmony is more than indicated in this attempt, for much still remains to be done before such a system as that which regulates the harmony of music can be established for the colourist. Yet, enough, perhaps, will be here found to urge more talented and more learned investigators to farther inquiry, in the same direction, and, in the mean time, to serve as a guide to the student.

ON

THE MODES IN WHICH THE PRINCIPLES OF BEAUTY ARE DEVELOPED IN COLOUR.

In all the phenomena of colour, such as are presented in the rainbow, the prismatic spectrum, and in other results of refracted light, as well as in those of light reflected from laminated substances, we find the union of the primary colours in that simple binary mode only, by which the secondary colours are produced; and however modified they may be in tone, tint, and shade, they are uniformly of this nature. Transient colours, therefore, seem to be capable of this simple kind of union only, and to be susceptible of no ternary mode of combination, excepting that which produces perfect neutrality. From this it would appear, that some further change in the action of light than that arising from mere refraction is necessary to produce those hues on which the more subtile and refined species of harmony so much depends. The modifying power of a primary upon a secondary colour, and *vice versa*, may therefore

be said to belong to inherent colours only; and with this understanding, I shall proceed to describe the nature of the beauty produced by its application.

Every proper arrangement of colour must have a key or tonic, and this key must be one of the primary or secondary colours introduced into the composition, and whether presented in a positive state of intensity, or merely as a neutralized hue, it must be assigned, and must be permitted to retain, an ascendancy over all the other colours with which it is associated. This ascendancy is given to the tonic colour by the maintaining of a due subordination to it in every hue, tint, and shade, with which it may be accompanied; while these accompaniments ought also to be subordinated relatively to each other, with equal attention to the laws of harmony. In the skill with which a balance of this ascendancy and subordination is maintained in every part of a composition, and in that with which the ruling tonic is repeated and modulated into other keys of harmony, consists the art of giving beauty and expression to colours.

When a primary or secondary colour in a pure state forms a tonic in any composition, the subordination of the principal contrasting colour by which it is accompanied is effected simply by its own tone being to a certain extent imparted to this contrasting colour, as exemplified in the constitution of the hues of red and green which form the scale (p. 37), exhibited in Example VIII.

As, according to Aristotle, "we are pleased with har-

mony, because it is the union of contrary principles having a ratio to each other," so the most beautiful arrangements of colour are those in which this subordination in the accompaniments to the tonic is effected by distinct and properly articulated intervals, having a simple numerical or harmonic ratio to it, and less simple ratios to each other. It is when there is a visible operation of this principle in the colouring of Nature, that the most beautiful effects are witnessed, and to its evident application in high art that the works of the best colourists of antiquity owe their excellence.

The colour introduced into any arrangement as the principal accompaniment to a primary tonic, ought to be that in which the primary itself exists in a small degree, as in the hue called *tempered secondary*. By this particular degree of subordination in the power of the principal accompaniment, that of the tonic is enhanced, and the primary colour rendered more brilliant and striking. But when a secondary colour is adopted as the tonic of a composition, the primary necessarily employed as an accompaniment should be doubly removed from intensity; because the power of a primary to a secondary being as 2 to 1, a double proportion of the latter colour is required for reducing it sufficiently to hold this subordinate situation, and giving the tonic, along with the harmony of contrast, the requisite degree of importance in the composition. Again, the power of the principal contrast ought to be softened and melodised by the introduction of others of a less posi-

tive character, but having to each other certain specific numerical ratios, as already pointed out.

The effect of the application of these general principles I shall exhibit in a simple manner by six examples of colorific harmony, in each of which one of the positive colours will form a key.

The first two of these harmonies are those arising from the contrast of red and green, which may be reckoned the most perfect, as well as the most pleasing species of harmony, being that in which nature most delights. It is the various modes of this harmony, developed in the stems, leaves, buds, and blossoms of trees, shrubs, and plants, that gives to spring and summer their colorific freshness and beauty, two familiar instances of which may be referred to. The first is the mellow contrast between the subdued red of the tender shoot of the hawthorn, and the fresh vernal green of its leaves; the other is the lively harmony that exists between the tint of delicately tempered green which distinguishes the leaves of many varieties of the rose bush, and the equally delicate, but more positive, tints of red peculiar to the petals of their flowers. But examples are so numerous that it is needless to particularise, for throughout all Nature a systematic harmony of red and green developes itself during these seasons of her joy and gaiety.

Of these two colours, namely red and green, individually considered, I have elsewhere remarked, that intense red is the most powerful of all colours in its effect upon the eye.

In the colouring of the animal and vegetable productions of Nature, it occurs but rarely in a state of pure intensity, and always in comparatively small quantities. Its effect in works of art is gorgeous and powerful, and on all occasions its predominance is expressive of ostentation and grandeur. Its contrasting colour, green, is of an opposite character, being more soft and agreeable to the eye than any other decided colour. Green is consequently Nature's favourite colour, prevailing to a far greater extent in the clothing of the earth's surface than any other; but it seldom appears in the vegetable kingdom in its most intense purity, its various tones being generally of a subdued and mellow character.

Red is much enhanced in effect by artificial light, while green is deteriorated and subdued, a fact which ought always to be kept in view in all decorative adaptations of this species of harmony.

In Example IX. the harmony of red and green is exhibited, red being the tonic, and tempered green the principal accompaniment, both being melodised by the hues that lie next them in series; that is, red by tempered red, and tempered green by green-hue; and in Example X. is shown the harmony of green and red, the secondary being the tonic, and the primary the accompaniment, which latter is held in double subordination, as already explained.

The harmony of yellow and purple is of a feebler kind than that of red and green, in so far as the power of ab-

stract colour is concerned, but it is stronger in respect to the opposition of the light and shade that necessarily enter into every colorific harmony. It is, therefore, of a less gay character, though far from approaching to gravity; being rather, as already remarked, characteristic of dignity and grandeur. Some of the most striking effects that colouring produces upon the general aspect of Nature, are the result of this species of harmony. For example, when the luxuriant green of summer gives place to the golden yellow of the ripened grain, and when the autumnal winds are slowly moving over the scene the massive, surcharged clouds of this particular season, how often do the alternations of light and shade thus produced between the brilliantly illumined fields, and the deep purple shade of the distant mountain, present this mode of contrast to the eye? In some of the more minute examples of Nature's colouring, this harmony is also particularly conspicuous; as one familiar example, I may mention the pansy, in the innumerable varieties of which, it is exhibited in every mode and degree of which the two colours that produce it are susceptible.

The harmony of yellow and purple is subject to the laws already referred to, in treating of red and green. Yellow, as an individual colour, has a degree of gaudiness that renders a certain degree of modification always necessary when it forms a large mass in a composition; while its contrasting colour, purple, is of an opposite character in this respect. Yellow becomes lighter, and purple deeper, in artificial light,

and as they both, at the same time, lose intensity of colour, their harmony in such light nearly approaches that of black and white. In Example XI., yellow is the key, and tempered purple the accompaniment; and in Example XII., purple is the key, and yellow-hue the accompaniment.

Blue and orange is a harsh contrast, and to reduce it to a pleasing harmony, the secondary ought to be doubly subdued, but, in order better to exemplify its peculiar nature, I have, in the examples, treated it in the same manner as the other two. The great power of contrast in this case, arises from the union of red with yellow in the orange, by which the warmth of the red is enhanced, while the blue retains its whole inherent coolness of tone. It is in regard to light and darkness, the opposite to the harmony of yellow and purple, for in it light predominates in the secondary, and darkness in the primary. An approximation to this kind of harmony is often seen in autumn, when the foliage of the woods has attained its richest tints: for the same atmosphere that appears purple in contrast with yellow assumes the character of blue when opposed to orange; and the more the orange colour approaches red in its tone, the more will the gray of the atmosphere approach a greenish hue. When orange becomes the tonic, tempered blue should form its accompaniment, because, as will be seen in Example XIV., the neutralization of this primary to its hue is too great, as that of the secondary in the previous example was in too small a degree. The contrast of blue and orange however, is,

under various modifications, productive of some of the most splendid effects in the colouring of Nature: I allude to the gorgeous combinations with which the day so often closes, while not only in the sky, but over all the face of Nature, the red golden lights of the setting sun are harmoniously contrasted with the tempered blue of the shadows.

While these general principles of modification are attended to, those of attenuation and reduction ought never to be lost sight of, for the latter often enhance greatly the beauty arising from the more precise mode of contrast produced by an adherence to the former.

The coloured examples show how beautifully warmth and coolness of tone are balanced in the harmonies of red and green, and of yellow and purple; while, from the causes just explained, these qualities produce a degree of harshness in that of blue and orange. Consequently it is often requisite, in this species of harmony, to soften doubly the asperity of the orange colour, by not only modifying it to a hue, but by also attenuating it to a tint; hence the pleasing harmony of blue and fawn colour, the latter being simply a tint of orange hue. The reduction of yellow to the tint called primrose, from the same cause, forms a pleasing contrast to pure purple; and the same may be said of the beauty arising from tints of red, when contrasted with intense or deep green.—(Note F.)

The tints and shades arising from the colours and hues in all the examples, are to be found in my Nomenclature.

NOTES.

NOTES.

Note A. p. 11.

The science of æsthetics, I conceive, to be thus constituted:—The subject is the human mind, and the object is external nature. Each individual mind may be considered as a homogeneous existence—a unit in creation—a world within itself. These two separate existences, the individual mind, and the world at large, have a relation to each other: the subject is affected by the object, and the media of communication by which this is performed, are the sensorium, and its inlets the organs of sense, the former being in direct contact with the subject, and the latter with the object. The organs of sense are acted upon in various ways, and by various modifications of the elements of the external world, but æsthetically the subject is affected in two ways only. These affections are either pleasing or displeasing—good or bad—the absence of the one quality constituting the presence of the other. When these qualities are equally balanced, no more effect is produced on the mind, than what two opposite colours produce on the organ of vision when they destroy each other in neutrality. This effect upon the subject results from a homogeneous principle existing in external nature, to the operations of which the internal sense responds. This response is called perception, and the science of æsthetics is devoted to the investigation of the modes in which

external objects—natural and artificial—affect this power of the mind. Beauty is pleasing to the perception—harmony in the combinations or motions of the elements of external nature constitute beauty; and harmony, according to Aristotle, is the union of contrary principles having a ratio to each other, so all beauty seems based upon a mathematical principle, and the observance of this principle in combining forms, colours, and sounds, may be considered an application of æsthetical science.

Note B. p. 12.

Goethe is, perhaps, the only writer upon colour, who does not look upon the accidental colours as ocular spectra or mere phantoms, but considers them the necessary conditions of vision; the lively alternating action of which, with reference to external ob-objects, indicates a principle of action within the eye.—*Theory of Colours*, Part I. p. 2.

But the manner in which the harmonics arise, that accompany or immediately succeed any given note in music, would lead us to believe that the accidental colours are acts of the object rather than of the subject; because it is well known that the harmonics or accidental notes in music arise from other undulations of the atmosphere accompanying those that produce the original note, and that these undulations are excited by a compound mode of vibration in the body which causes them. I therefore conceive that light may be an independent molecular action in the atmosphere, and that its modes produce every variety of colour, in the same way that the modes of undulation produce every variety of sound, and that consequently the mode of action that produces one colour, simultaneously excites those modes that produce the harmonic colours.—*See Appendix to my Nomenclature of Colours, &c.*

NOTE C. p. 15.

The two exemplifications to which I have alluded, are given in my Essay on Ornamental Design, and will, I believe, be found sufficiently interesting to the general reader to excuse their introduction here in illustration of the general principle.

Let the whole length of a perfect skeleton be divided into 90 parts, the first grand division is from the sole of the foot to the *os pubis*, and it contains 45 of those parts (the ratio to the whole of 1 to 2). The second from the same to the fifth or last *vertebra* of the loins, 60 parts (ratio 2 to 3). The third from the same to the upper bone of the *sternum* or breast bone, 72 parts (ratio 4 to 5), From the same to the bottom of the lower *mandible* or jaw-bone $78\frac{3}{4}$ parts (ratio 7 to 8). From the same to the top of the same bone, 80 parts (ratio 8 to 9). From the same to the top of the *os ileum* or flank bone, 54 parts (ratio 3 to 5). From the same to the bottom of the *os sacrum* or great bone of the spine, 48 parts (ratio 8 to 15). From the crown of the head to the bottom of the *patella* or knee bone, $67\frac{1}{2}$ parts (ratio 3 to 4). From the crown of the head to the bottom of the first *vertebra* of the back, and from the top of the *os sacrum* or great bone of the spine, to the *atlas* or uppermost *vertebra* of the neck, are each 30 parts (ratio 1 to 3). From the bottom of the *os pubis* to that of the *patella*, and from the bottom of the *patella* to the sole of the foot, each $22\frac{1}{2}$ parts (ratio 1 to 4). From the crown of the head to the bottom of the first bone of the *sternum*, from the *os pubis* to the first *vertebra* of the back, from the *clavicle* to the lowest rib, and from the top of the *humerus* or large bone of the arm to its junction with the *ulna* and *radius*, each 18 parts (ratio 1 to 5). From the *os pubis* to the top of the fifth or last *vertebra* of the loins, and from the crown of the head to the twelfth or last *vertebra* of the back, are each 15 parts (ratio 1 to 6). The fore-arm,

from where the *ulna* and *radius* join the *humerus* to their union with the lunar bones of the wrist, is about 13 parts (ratio 1 to 7). The length of the facial surface from the crown of the head to the point of the chin, the length of the sternum or breast bone, and the vertical length of the *pelvis* are each $11\frac{1}{4}$ parts (ratio 1 to 8). The *cranium* from its highest point to where it joins the *atlas*, is $7\frac{1}{2}$ parts (ratio 1 to 12),

The parts of the human body are no less remarkable for the harmony of their subdivisions. In the arm the *radius* and *ulna* are to the *humerus* in the ratio of 2 to 3. The hand, from the wrist bone to the point of the longest finger, is to the whole length of the arm (hand included) in the ratio of 1 to 4. The length of the foot is to the length of the leg, taken from the sole of the foot to the head of the thigh bone, in the ratio of 1 to 4. The division of the human countenance into the harmonic ratios is equally worthy of notice in this place. On the transverse diameter, from the crown of the head to the centre of the eye, is in the ratio of 1 to 2 of the whole length. From the same to the point of the nose, 3 to 4; and to the mouth, 5 to 6. From the point of the chin to the mouth, 1 to 6; to the nose, 1 to 4; to the centre of the eye, 1 to 2; and to the setting on of the hair, 5 to 6. Upon the conjugate diameter, the eye, the width of the nose and the mouth are as 1 to 5. Every minutiæ of the human figure is full of this species of harmony. The eye itself in its division into the parts by which its extraordinary functions are performed, displays it in an eminent degree, as I have endeavoured to show in another work.*

* "Proportion, or the Geometric Principle of Beauty Analysed." William Blackwood and Sons. London and Edinburgh. 1843.

NOTE C. CONTINUED.

The ratios in the human body are in the order of their simplicity as follow :—		These ratios in the pulsations of the atmosphere, produced by similar divisions of the monochord, are called,
Ratios.		
1 to 2	.....	An octave.
1 ... 3	.....	A twelfth.
1 ... 4	.....	... fifteenth or second octave.
2 ... 3	.....	... fifth.
1 ... 5	.....	... seventeenth.
1 ... 6	.....	... nineteenth.
3 ... 4	.....	... fourth.
1 ... 7	.....	
3 ... 5	.....	... sixth.
1 ... 8	.....	... twenty-second or third octave.
4 ... 5	.....	... third.
5 ... 6	.....	... third minor.
1 ... 12	.....	... twenty-sixth.
6 ... 7	.....	
8 ... 9	.....	... major tone or second.
8 ... 15	.....	... seventh.

The proportions of the portico of the Parthenon at Athens, have for many ages excited the admiration of mankind, and are still referred to as the most perfect example of this kind of beauty known in architecture. It is therefore a subject of some interest to inquire into the nature of those proportions, and especially to ascertain how far they are governed by the same principle of ratio just exemplified in the human figure. The two subjects are quite dissimilar in general contour, there being no conceivable likeness between a Grecian portico and a human figure. But the beauty of their proportions are traceable to a similar principle differently applied. In the human figure it has been shown that the proportions consist in the

division of an imaginary or mathematical straight line passing through the centre of the leading bones in the skeleton; and in the portico the operation of the same principle of harmonic ratio, will be seen upon the imaginary line called the diagonal in each of those rectangles which, combined together, forms what may be fairly termed its skeleton. But it is not in the various lengths of these diagonal lines that we are to look for the developement of the harmonic ratios, but to the degrees of the angle they form with the longest side of each rectangle, which, of course, when vertically placed, must be above, and when horizontally placed, below 45°; and the following is the result.

The entire portico, from the extreme of the base of the outer columns to the upper point or apex of the pediment is inscribed in a rectangle, the diagonal of which is 30°, bearing to the angle of 45°, the ratio of 2 to 3, and to the angle of 90°, that of 1 to 3.

The angle of the pediment itself is 15°, bearing to the diagonal of the inscribing rectangle the ratio of 1 to 2; to the angle of 45°, that of 1 to 3; and to the angle of 90°, that of 1 to 6.

The diagonal of the rectangle under the pediment inscribing the columns with their architrave and frieze is 22° 30′, bearing to the diagonal of the inscribing rectangle, the ratio of 3 to 4; to the angle 45°, that of 1 to 2; and to the angle 90°, that of 1 to 4.

The diagonal of the rectangle inscribing the columns is 18°, bearing to the diagonal of the inscribing rectangle, the ratio of 3 to 5; to the angle of 45°, that of 2 to 5; and to the angle of 90°, that of 1 to 5.

The diagonal of the rectangle inscribing the architrave and frieze is 5° 37′ 30″, bearing to the diagonal of the inscribing rectangle, the ratio of 3 to 16; to the angle of 45°, that of 1 to 8; and to the angle of 90°, that of 1 to 16.

The rectangles of the six centre columns, which I have taken at their mean diameter, have each a diagonal of 80°, bearing to

the angle of 90°, the ratio of 8 to 9; and the five intercolumniations between these have each a diagonal of 75°, bearing to those of the columns, the ratio of 15 to 16, and to the angle of 90°, that of 5 to 6.

The rectangles of the two outer columns and their intercolumniations have diagonals of 78° 45′, being to the right angle in the ratio of 7 to 8.

The harmonic ratios of the Parthenon are therefore in the order of their simplicity as follows:—		Names of those ratios when applied to the vibrations produced by the division of the monochord.
Ratios of		
1 to 2	.....	An octave.
1 ... 3	.....	A twelfth.
1 ... 4	.....	... fifteenth or second octave.
2 ... 3	.....	... fifth.
1 ... 5	.....	... seventeenth.
1 ... 6	.....	... nineteenth.
2 ... 5	.....	... tenth.
3 ... 4	.....	... fourth.
3 ... 5	.....	... sixth.
1 ... 8	.....	... twenty-second or third octave.
5 ... 6	.....	... minor third.
1 ... 16	.....	... twenty-ninth or fourth octave.
8 ... 9	.....	... major second or tone.
3 ... 16	.....	An eighteenth.
15 ... 16	.....	A semitone or minor second.

When any object is presented to the eye, its variety, either of colour or form, is at once apparent, and to a perfect organ and quick perception its beauty also, if it possess any. But the manner

in which the uniformity that constitutes beauty is imparted to this variety, can be perceived only through a knowledge of that governing mathematical law of harmony and proportion already noticed. The human figure owes much of its beauty to variety, but when we examine carefully the relative proportions of its parts, it will be found that in the most perfect specimens the uniformity is in the ratio of the variety; and further, that this uniformity amidst variety is produced by the same harmonic ratios that regulate the laws of acoustics and chromatics.*

Note D. p. 25.

It will be observed, that throughout this Essay, I have adopted another hypothesis of the production of transient colours, that is, that they are the result of the action of light upon shade, and not the separation of light into its elements. This is not a new theory, for it was originally advanced by Aristotle, and afterwards adopted by Leonardo da Vinci. Neither has it been set aside by modern investigators, for Goethe has taken the place of Aristotle, and may be said to have now established it as a fact in natural philosophy, while his translator, Eastlake, has, like Leonardo da Vinci, adopted and elucidated it as connected with the practice of high art.

Goethe states his opinion in the following terms:—"Light and darkness, brightness and obscurity, or, if a more general expression is preferred, light and its absence, are necessary to the production of colour. Next to the light, a colour appears which we call yellow, another appears next to the darkness which we call blue. When these, in their purest state, are so mixed that they are exactly equal, they produce a third colour called green. Each of the two first named colours can, however, of itself, produce a

* "Essay on Ornamental Design," &c. D. Bogue, London; J. Menzies, Edinburgh. 1844.

new tint by being condensed or darkened; they thus acquire a reddish appearance, which can be increased to so great a degree that the original blue or yellow is hardly to be recognised in it; but the intensest and purest red, especially in physical cases, is produced when the two extremes of the yellow-red and blue-red are united. This is the actual state of the appearance and generation of colours. But we can also assume an existing red in addition to the definite existing blue and yellow, and we can produce contrariwise, by mixing what we directly produce by augmentation or deepening. With these three or six colours, which may be conveniently included in a circle, the elementary doctrine of colours is alone concerned. All other modifications, which may be extended to infinity, have reference to the technical operations of the painter and dyer, and the various purposes of artificial life. To point out another general quality, we may observe, that colours throughout are to be considered as half-lights, as half-shadows, on which account, if they are so mixed as reciprocally to destroy their specific hues, a shadowy tint or grey is produced."—*Goethe's Theory of Colours, translated by Eastlake.* Introduct. pp. xlii. xliii.

In a Note upon Goethe's Theory, p. 365, Eastlake says, " That the opinion so often stated by Goethe, namely, ' that increase of colour supposes increase of darkness, may be granted without difficulty.'—In another note (p. 387) he observes :—" Aristotle's notion respecting the derivation of colours from white and black, may perhaps be illustrated by the following opinion on the very similar theory of Goethe.

" Goethe and Seebeck regard colour as resulting from the mixture of white and black, and ascribe to the different colours a quality of darkness (σκιερὸν) by the different degrees of which they are distinguished, passing from white to black through the gradations of yellow, orange, red, violet, and blue; while green appears to be intermediate again between yellow and blue. This

remark, though it has no influence in weakening the theory of colours proposed by Newton, is certainly correct, having been confirmed experimentally by the researches of *Herschell*, who ascertained the relative intensity of the different coloured rays, by illuminating objects under the microscope by their means.

" Another certain proof of the difference in brightness of the different coloured rays, is afforded by the phenomena of ocular spectra. If, after gazing at the sun, the eyes are closed, so as to exclude the light, the image of the sun appears at first as a luminous or white spectrum, upon a dark ground, but it gradually passes through the series of colours to black; that is to say, until it can no longer be distinguished from the dark field of vision; and the colours which it assumes, are successively those intermediate between white and black, in the order of their illuminating power or brightness, namely yellow, orange, red, violet, and blue. If, on the other hand, after looking for some time at the sun, we turn our eyes towards a white surface, the image of the sun is seen at first as a black spectrum upon the white surface, and gradually passes through the different colours, from the darkest to the lightest, and at last becomes white, so that it can no longer be distinguished from the white surface."—" *Elements of Physiology," by J. Muller, M. D. Translated from the German by William Bailly, M. D. London*, 1839.

" It is not impossible that Aristotle's enumeration of the colours may have been derived from, or confirmed by this very experiment. Speaking of the after-image of colours, he says, ' The impression not only exists in the sensorium in the act of perceiving, but remains when the organ is at rest. Thus, if we look long and intently on any object, when we change the direction of the eyes, a corresponding colour follows. If we look at the sun, or any other very bright object, and afterwards shut our eyes, we shall, as if in ordinary vision, first see a colour of the same kind; this will pre-

sently be changed to a red colour, then to purple, and so on, till it ends in black and disappears."—*De Insomniis.*

Such authorities would have been quite sufficient to warrant me in adopting this hypothesis of light and shade operating in the production of colour. But previously to my acquaintance with them, I felt convinced that the appearance of the three primary colours in the solar spectrum, was the result of the ternary division of the action of light upon darkness, performed by the three-sided prism, and that its action was in the progressive ratio of 3, 2, 1, the ratio that the colours bear respectively to light and shade.

Note E. p. 50.

In a previous work,* I have made such an attempt, and have given examples of upwards of 220 tints and shades, which, by the manner of their arrangement, are made to exhibit upwards of 100 varieties of contrast.

Regret has often been expressed by writers on this subject, that the primary colours cannot be had in pigments of greater purity, and more equally balanced in respect to their relative effects; but this want is not of so much importance as is generally attached to it—the true desideratum having been a proper method of combining and harmonizing such as are within our reach. From what I have endeavoured to show in regard to the effects of the harmonic ratios when applied to colour, it appears of little importance whether the three elementary colours, employed as the tonic medient and dominant in a composition, be perfectly pure or not, if they be perfect in their relations of 1, 2, 3, and 3, 2, 1, to one

* "A Nomenclature of Colours, Hues, Tints, and Shades." W. Blackwood and Sons. Edinburgh and London. 1845.

another. Should they want purity, by being all more allied to shade than to light, all the hues arising from their union will be proportionately low, and the same quality will pervade the general tone of the composition. If, on the other hand, they should want power by being reduced in intensity, and more allied to light,—then will lightness diffuse itself over the various harmonies that arise from their modes of union. Light colours are of a retiring character, consequently, as they receive additional depth they come forward, until they attain the medial position of an equal balance, which is the proper pitch of pure intensity, after which, if the deepening process be continued, they again begin to lose their intensity, and their power upon the eye, and to retire into shade.

Note F. p. 58.

On this subject Eastlake truly observes, that the complimental colour pictured on the retina is always less vivid, and always darker or lighter than the original colour, and that this variety accords more with harmonious effects in painting than those contrasts in which the opposite colours are of equal intensity, because, "in addition to the mere difference of hue, the eye, it seems, requires difference in the lightness or darkness of the hue."—*Note C. on Goethe's Theory of Colours.*

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"These works are highly honourable to Mr Hay as a practical man. He has been long known as an extensively employed and elegant Artist in the department of Decorative Painting; and he has found leisure, notwithstanding the pressure of his professional avocations, to appear before the Public as an Author, with strong claims to its attention and respect. He is one of the few artists who have drawn the resources of their profession from the recognised fountains of knowledge; and who, in offering the lessons of their experience at the shrine of Science, have been anxious to listen, in return, to her infallible counsels. The disposition to this species of exchange, and to introduce into the intellectual community the principles of free intercourse, is by no means general; but we are confident that Art will not sufficiently develope her powers, nor Science attain her most commanding position, till the practical knowledge of the one is taken in return for the sound deductions of the other.

"Many causes have concurred to place art and science at variance; but these causes have been gradually diminishing, and in the present advanced state of the mechanical and useful arts, they have almost wholly disappeared. It is in the fine arts, principally, and in the speculations with which they are associated, that the controlling power of scientific truth has not exercised its legitimate influence. In discussing the principles of painting, sculpture, architecture, and landscape gardening, philosophers have renounced science as a guide, and even as an auxiliary; and a school has arisen whose speculations will brook no restraint, and whose decisions stand in opposition to the strongest convictions of our senses. That the external world, in its gay colours and lovely forms, is exhibited to the mind only as a tinted mass, neither within nor without the

eye, neither touching it nor distant from it—an ubiquitous chaos which experience only can analyse, and touch transform into the realities which compose it; that the beautiful and sublime in nature and in art derive their power over the mind from association alone, are among the philosophical doctrines of the present day, which, if it be safe, it is scarcely prudent to question. Nor are these opinions the emanations of poetical or ill-trained minds, which ingenuity has elaborated, and which fashion sustains. They are conclusions at which most of our most distinguished philosophers have arrived. They have been given to the world with all the authority of demonstrated truth; and in proportion to the hold which they have taken of the public mind, have they operated as a check upon the progress of knowledge.

* * * "While opinions like these were considered as sound and well established, philosophers never thought of studying the laws of visible direction in single and double vision, by which all the difficulties of the subject have been subsequently removed; and in like manner, while the present theories of taste prevail, there can be no inducement to discover the rules of harmonious colouring, or to investigate the origin of beautiful forms, or to develope the laws of regular and irregular symmetry. When speculation, however, is thus in the ascendant, and theorists least apprehensive of danger, truth is often securing auxiliaries from localities the least likely to supply them. The sovereignty of association in matters of taste had never been recognised by practical men, who study nature principally through the eye; and the painter, the sculptor, the architect, and the landscape gardener, had been striving in their respective spheres to discover those 'Laws of Harmony,' both in colour and form, which ought to regulate the taste, and direct the hand of the artist. In so far as we know, Mr Hay is the first and the only modern artist who has entered upon the study of these subjects without the trammels of prejudice and authority. Setting aside the ordinances of fashion, as well as the dicta of speculation, he has sought the foundation of his profession in the properties of light, and in the laws of visual sensation, by which these properties are recognised and modified. The truths to which he has appealed are fundamental and irrefragable; and the conclusions which he has deduced from them, will admit of no modification either from taste or fashion. In the adaptation of his principles, indeed, to the various circumstances in which they are to be applied, taste and judgment are undoubtedly required; and even in the decoration of the boudoir and the drawing-room, harmony of colour, and symmetry of form, may be made to coexist with, and even to control, the caprices of fashion, and the glitter of meretricious ornament.

"Notwithstanding some trivial points of difference between Mr Hay's views and our own, we have derived the greatest pleasure from the perusal of these works. They are all composed with accuracy, and even elegance. His opinions and views are distinctly brought before the reader, and stated with that modesty which characterises genius, and that firmness which indicates truth."

The British and Foreign Medical Review. No. XXXV. P. 171.

"There is harmony of numbers in all nature—in the force of gravity—in the planetary movements—in the laws of heat, light, electricity, and chemical affinity—in the forms of animals and plants—in the perceptions of the mind. The direction, indeed, of modern natural and physical science is towards a generalization, which shall express the fundamental laws of all by one simple numerical ratio. We would refer to Professor Whewell's 'Philosophy of the Inductive Sciences,' but more particularly to Mr Hay's 'Researches into the Laws of Harmonious Colouring and Form.' From these it appears that the number Seven is distinguished in the laws regulating the harmonious perception of forms, colours, and sounds, and probably of taste also, if we could analyse our sensations of this kind with mathematical accuracy. We think modern science will soon show that the mysticism of Pythagoras was mystical only to the unlettered, and that it was a system of philosophy founded on the then existing mathematics, which latter seem to have comprised more of the philosophy of numbers than our present."

Fraser's Magazine.

"We have now gone over all Mr Hay's works; but, we confess, not in a manner calculated to do them the justice they deserve. This, indeed, could be done only in the pages of a work devoted to scientific pursuits, and whose particular class of readers may be supposed to possess that peculiar turn of mind which delights in philosophical inquiry, and in the abstruse investigations of science. In a periodical like ours, such inquiries would be out of place.

"Yet, enough has been said, it is presumed, to show that the author of the works we have just been noticing is a remarkable man. He undoubtedly is. He is a leader in his vocation; one of those men who stand prominently out in the front of his fellows, and who, by the force of original genius, have acquired a certain ascendency over the public mind.

"Looking to the philosophical spirit and character of Mr Hay's treatises, we cannot but consider them valuable acquisitions; their purpose being to improve the general taste, and by consequence, for it is a consequence thereof, to contribute to the advancement of civilization."

The Athenæum.

" The study of *the true*, *the good*, and *the beautiful*, has formed an important occupation of life in all highly civilized nations, and has been inculcated by the truest patriots and the highest philanthropists. Science, virtue, and beauty, form the noblest elements of creation, and of the human soul—they form the first objects of our national institutions, the highest elements of a national character, and the best themes of a national literature.

" It would be a great step in the advancement of our national civilization, were the love of the beautiful and the power of appreciating the value of its manifestations, more intimately mixed up with the associations and habits of our countrymen. That we have artists of high powers—architects of consummate skill—that we have, or have had, Barrys and Cockerells, Wilkies and Ettys, Landseers and Mulreadys, Flaxmans and Chantreys and Westmacotts, is matter of national congratulation ; but does little to prove the existence of a high standard of national taste. The habit of enjoying the beautiful, and the power of appreciating it, should pervade the national character, should determine its national institutions, and be diffused among the peasantry of our streets and hamlets ' The farmer and the mechanic (we quote Channing) should cultivate the *perception of beauty*.'—' Every man should aim to impart this perfection to his labours.' Were every man a judge and appreciator of beauty, then indeed might we expect forms of loveliness and grace to pervade the regions of domestic and everyday life—to replace, in our streets, the expensive ugliness of our street decoration—in our homes, the vulgarities of ornamental deformity—and in our churches, the distortions and anomalies of meretricious decoration.

" We hail, therefore, with delight the appearance among us of any evidence of progress towards the diffusion of correct principles in taste, of accurate knowledge of art,—and we receive the work before us as a harbinger of better times—as an index of the wider diffusion of knowledge in art.

" ' Hay on Harmonious Colouring' formed the precursor to ' Hay on the Harmony of Form.' The former work was chiefly designed to correct and direct the public taste in the decorations of domestic life ; the present has a higher aim—the determination of the forms and proportions which give to objects and structures a maximum of beauty.

" Mr Hay's proportions, as assigned to form, are most correct and most beautiful : they are *not*, however, those of the beautiful sounds to which he assigns them,—and are not *therefore* beautiful. But it does not follow that because they are *not therefore* beautiful, they are necessarily *therefore not* beautiful ;—on the contrary, the beauty, whose proportions he assigns, has been the beautiful of all time—at least, of all civilization.

" It is only necessary to glance the eye over Mr Hay's eighteen beautiful plates, to learn that, however we may differ from him as to *why beauty is*, we cannot dissent from him as to *what is beautiful*. We feast the eye with geometrical symmetry as we turn over the figures on his plates.

" The fact that Mr Hay, by an independent process of his own mind, versant about proportion and beauty, has arrived exactly at some of the identical proportions of the Platonic Theory, as we understand and apply it, is to be reckoned as an important psychological phenomenon, demonstrating the inherence of certain fixed and essential principles of proportion and beauty in the human soul.

" The two symmetrical triangles of Plato are,—1. That triangle which is half of the square ; and 2. That which is half of the equilateral triangle. The first exemplifies the relations of the number two, and the second adds to these the properties of the number three. Calling the least angle one, the magnitude of the next is two, and of the next three. If, then, we try these triangles by the canon of criticism of Michael Angelo, we find them bearing, in the highest possible degree, the combinations of his numbers, one, two, and three.

" Now, then, Mr Hay's *Do* is the circle, his *Re* is the parallelogram, which is composed of a pair of triangles of the *second* species of Plato ; his *Mi* also consists of a pair of the same, with their largest side outermost ; his *Fa* is a group of four of these triangles ; his *Sol* is a pair of the first species of Plato ; his *La* is an ellipse, whose axes are in the proportion of two of the sides of the second species of triangle ; and his *Si* is a group of twelve of these triangles ranged round a point.

" All Mr Hay's proportions are, therefore, good. They exist in the best specimens of perfect architecture ; they are necessary elements in judicious decoration. They give rise to symmetry and simple numerical proportions in angular compositions. They pervade the works of the Greek artists, and were the identical principles taught by the philosophers who gave wisdom to the times of Pericles and Phidias."

The Court Gazette.

" This is a work of great talent and value. It has the peculiar merit of being new and original, in the midst of the sickly spirit of repetition, which seems to shed its drowsy influence over the largest department of modern publication. It is devoted to form. The author is one of the individuals peculiarly endowed with that rich gift which constitutes the sculptor, the architect, and the painter ; and hence the ingenious theory developed in this work, which logically associates sight with sound, geometry with acoustics. It is the developed theory of Plato, who eloquently commented on the music of beautiful forms ; a theory which Darwin, the Platonic poet, in a note to his ' Temple of Nature,' practically carries out, by suggesting the construction of a machine which, while producing the varied notes of the gamut to the ear, should, at the same time, present to the eye the ' various modulations' of the prismatic colours. Mr Hay's theory is somewhat like this ; but practically developed for the painter, the sculptor, and the architect. The il-

lustrated architectural examples deserve especial notice. The geometrical production of the *façade* of a Doric temple, from the projected combination of the vescica piscis, or double circle—(the freemason's secret of Ancient Egypt, and the monastic architects of the middle ages)—is most curious. We cordially recommend to our readers this ingenious work, which is profoundly philosophical in its geometrical analysis of abstract form, and replete with the exciting spirit of poetry and music in its tasteful associations."

The Sun.

"The object of this treatise is to show that the impressions made upon the eye by forms are really founded on natural principles; and that the proportions and peculiarities of form which produce the most pleasing impressions, are in reality, as well as appearance, dictated by nature, being a response to those principles in the human mind. The treatise is singularly well written, both as respects manner and matter, exhibiting a force and closeness of reasoning which lead to the inference that the author has a decided penchant for mathematical pursuits, and is extensively acquainted with that difficult and complicated science. Harmony of form, he observes, depends upon three homogeneous parts, and these parts are analogous in every respect to the three homogeneous primitive sounds, proved by the concurrent testimony of natural philosophers to be the foundation of harmony in music. The writer then goes on to state that there are only three kinds of lines used in producing forms, and that these are the straight line, the crooked line, and the curved line: adding, 'all varieties of form, however complex—all the similarity and dissimilarity that combine in the harmony of forms, are produced by these simple elements.' The varieties of which these three kinds of lines are capable are next considered, after which the author gives several curious and interesting plates, illustrative of certain theories advanced in the course of his treatise. These plates are finished off with the utmost nicety, and artists and men of science will derive many a useful suggestion from them.

The Scotsman.

"Mr Hay, our ingenious and respected townsman, has discovered a very remarkable analogy between the natural principles of Harmony in Form, and those of Sound and Colour; and in short he has, in our opinion, unfolded another link in the great chain of simplicity and unity, of similarity and identity, which binds together all the elements of the material creation.

"It is to the developement of this curious fact that Mr Hay has devoted his ingenious work, which it is our purpose warmly to commend to public notice. Diagrams are given which bear out all his ideas. We are glad to learn, however—the present essay being too short—that the author has the intention of giving his investigations a more popular and extended form; and we may then hear those who smile at the inquiry as fanciful though ingenious, making admission that Mr Hay has in reality advanced one step onwards in the great course of simplifying the phenomena of the universe. We would encourage him in his progress. Let him remember that the discoverers of *truth* are ever *ultimately* honoured and rewarded."

The Glasgow Herald.

"Mr Hay is well known as the author of an ingenious work upon 'Colour,' in which he endeavours to show that an exact analogy exists between the principles of harmony in colouring and harmony in sound. But although this theory of harmonious colouring is highly interesting, and is illustrated by its author in such a manner as to create a strong impression of its accuracy, it is not in its nature absolutely capable of demonstration—at least our knowledge of colour is yet too imperfect to furnish an absolute test of its truth. But we are differently placed in relation to music and form: the notes of the former being ascertained simply to consist of undulations of air following one another in certain definite ratios of rapidity, and the proportions of the latter being capable of accurate geometrical measurement. Mr Hay's theory of the harmony of form can, therefore, be put to a more rigid test than that of his original one of the harmony of colour.

"Assuming that there are certain principles in nature which regulate those relations which we instinctively feel to be harmonious or discordant in colour and form as well as in sound, Mr Hay's doctrines, if ultimately proved to be correct, will establish another illustration of the simplicity with which nature works to all her ends, and produces all her effects; for their object is to show that what constitutes beauty in the combinations of colours, of forms, or of sounds, are all referable to the same standard, and consists in their being placed, in regard to each other, at certain intervals, corresponding exactly with those of the musical scale.

"It is, of course, impossible, in a cursory notice like this, to do more than indicate the general character of the very profound, as well as extremely interesting theory which Mr Hay has propounded. In so far as the precise proportions of numbers are concerned, we have seen it questioned whether the ratios of vibrations in the musical scale, and of circumferences in his scale of form, correspond so very accurately as he takes for granted. That they approximate there is no doubt, and their mere approximation is sufficient to give a high degree of speculative interest to the investigation of those principles of harmony of form which he has so ably instituted. That they do exist in nature, and may, by earnest philosophical inquiry, be successfully expiscated, may at least be regarded as points already established by his ingenuity and perseverance; and to have taken the lead in such an investigation, is, of itself, an honour not much less than that of attaining, if attained by another, its ultimate demonstration. We have said enough to induce such of our readers as take an interest in such inquiries to consult Mr Hay's work itself as to his views. The volume, we may remark in conclusion, contains numerous most beautiful diagrams, illustrative of the author's theory, and the reader may feel himself amused, as well as instructed, by studying 'the melody of the portico of the Parthenon,' expressed in musical notes, as well as by the intervals of Mr Hay's scale of harmony of form."

The Glasgow Citizen.

"This is decidedly an able as well as original publication, in some degree in the subject, but more so in the author's manner of treating it.

"Mr Hay considers that there is a strict analogy betwixt forms, sounds, and colours, and that, as in acoustics, there are three original or primitive sounds—the tonic, the mediant, and the dominant; and in colours, three which are primary and uncompounded—blue, red, and yellow; so, in form, harmony is dependent upon three grand elements or primary forms—the circle, the triangle, and the square. This forms the subject of the able and ingenious treatise before us, and is supported, we might say proved (did we consider ourselves competent to the thorough examination of the proof), by a variety of arguments closely and ingeniously put together, and enforced by copious illustration and example, as well as by various curious and well-imagined diagrams, and elevations of celebrated buildings. To persons of taste and knowledge in art, Mr Hay's work will be peculiarly acceptable, and we are confident that such will consider it as no slight contribution to the cause of art and science."

The Caledonian Mercury.

"This treatise on the principles of linear harmony, will eminently conduce, we think, to one main object, which its ingenious author seems to have had in view; namely, the improvement and guidance of the public taste in judging of works of art that owe their excellence to beauty of form. Mr Hay has here undertaken to demonstrate, and, so far as we are able to judge, he has done so clearly and convincingly, that the impressions made upon the eye by forms are really founded on natural principles; that the proportions and peculiarities of form which produce the most pleasing impressions are dictated by nature, being a response to these principles in the human mind; and that forms are, in all respects, analogous to sounds; so that a system of linear harmony may be established similar to that which regulates the arrangement of musical notes. It is impossible here to follow Mr Hay in the train of reasoning by which he elucidates the above positions, and traces the perfect analogy between the laws which regulate the harmony of sound and of form, as his deductions are in a great measure established by reference to a numerous series of plates of figures, which render palpable to the eye the beautiful theory of the text. We can only refer our readers to the tasteful volume itself, as an attentive perusal of it, we are convinced, they will not esteem labour lost. To the architect, Mr Hay's work indeed must be one of great interest and utility; and generally to all who study the arts of design and analogous branches of taste, so novel and original an exposition of the natural principles of form in their analogy to those of sound and colour, cannot fail to be singularly attractive."

NOTICES OF "THE LAWS OF HARMONIOUS COLOURING," &c. IN

Fraser's Magazine.

"In the absence, in the general case, of all indications of taste in the internal decorations of our dwellings, or which is, perhaps, yet more to be lamented, in the presence of the evidences of a bad one, our understandings have been hitherto wrapped in a kind of Cimmerian darkness, as regards the employment of decorative painting for domestic purposes, for the embellishment of our dwellings. A ray of light, however, and a brilliant one, has been let into this dark profound by Mr Hay, who not only points to a better state of things, but leads the way. Urged by the irrepressible energies of an active, vigorous, and original mind, Mr Hay has stepped from the ranks of a profession, hitherto of the humblest pretension—a profession whose practice was thought to require little judgment and still less taste—and has rendered himself remarkable by the ability with which he exposes this fallacy. Mr Hay has, in truth, elevated house-painting to the dignity of an art; an achievement which he has accomplished simply by recognising principles, the power of which in producing the *most beautiful*, in both form and colour, his own practice has long illustrated. In his *Laws of Harmonious Colouring*, Mr Hay blends the scientific with the practical, which, in popular language, means two things: first, that he begins at the beginning of his subject; and, second, that he gives reasons for all he advances.

"The work which we have just named has been too long before the public to render it necessary to give a detailed account of its objects and purposes here. We need but briefly state, that these are principally to introduce a better taste in house-painting or interior decoration than has hitherto prevailed; and to show that this can be effected only by a very vigilant attention to the harmonious relations of colours to each other throughout all their ramifications of hues, tints, and shades; taking care that no harsh contrasts nor incongruous associations offend the eye, but that the whole present that bland consistency which is so agreeable to contemplate, and which fills the mind with such pleasurable sensations. Such effect, cannot, however, be produced without a rigid adherence to principles, without a knowledge of, and compliance with, the laws that regulate the harmonious disposition of colours. It cannot be produced by chance, neither can it be produced in all circumstances, nor at any time, in greatest perfection, even by experience. Uniform and certain results can be derived from the operation of principle alone. This Mr Hay well understands, and it is the doctrine, *par excellence*, which he most anxiously inculcates, and which, in all his works, he most urgently presses on the attention of the reader. He knows that amongst a thousand diverging paths there is but one that leads to the most beautiful; and that, therefore, it is next to an impossibility that this path should be

taken by any but those who know the marks and signs by which it is indicated. As well might the mariner seek his way across the trackless ocean without the aid of the compass, as the artist seek to attain the most perfect results in his art without a knowledge of, and adherence to, the principles on which it is founded. For what the compass is to the one, is such knowledge to the other.

" Mr Hay, as will be observed by the title, has added to the present edition of his work on colouring, *An Attempt to define Æsthetical Taste.*

" This treatise is characterized throughout by a searching and highly philosophic spirit, by vigorous thought, and a very remarkable clearness of perception. So remarkable, indeed, is it for these qualities, that we wish Mr Hay had quoted less and written more ; that he had been more liberal of his own opinions and more sparing of those of others, as we greatly prefer his own remarks in almost every instance to those of the authors he quotes.

" The art of house-painting has hitherto been considered a very humble one ; but it would be no difficult task to show, that it is far from being so inherently, and that its degradation was wholly the result of combined negligence and incapacity. The proof of this may be found in the elevation to which it has been raised by the genius and talent of Mr Hay."

The Spectator.

" Mr D. R. Hay, of Edinburgh, affords another and a striking proof of the advantage, as well as the pleasure, derivable by a craftsman in intellectualizing his labour by scientific study. He thoroughly understands his subject—a merit that does not belong to all writers—and he lays down the principles of Harmony in Colour, as applicable to decorative purposes, explicitly and fully, and in a practical manner."

The Morning Chronicle.

" In the early part of his work, Mr Hay throws a most important light on the theory of Colours, by the agency of which he has been enabled to go much further towards the elucidation of this subject than any previous writer. He then, in a lucid manner, explains the relations which colours, in their various tints, hues, and shades, should have to each other to produce an harmonious result.

" After the extracts we have made, it is hardly necessary to observe, that this is a work of great originality ; and we have not the least hesitation in adding, that we believe that a diffusion of the knowledge of the principles laid down in it, would prove of material use to our manufacturers. In addition also to the utility of the study of those laws which regulate Harmonious Colouring to those engaged in productive industry, there can be little doubt that a knowledge of them would greatly enhance the pleasure derived from pictorial art."

The Atlas.

" This is a new and improved edition of Mr Hay's work on the *Laws of Harmonious Colouring*, and is adapted to every art and science in which colours form an accessory. Every line of this useful book shows that the author understands his business ; and he has contrived to intellectualize his subject in a very interesting manner. The principles of harmony in colour, as applied to decorative purposes are explained and enforced in a lucid and practical style, and the relations of the various tints and shades to each other, so as to produce an harmonious result, are descanted on most satisfactorily and originally. The application of the laws of colouring to house-painting is an era in science ; and the precepts given cannot fail to dignify the calling, by converting it into an imaginative as well as an agreeable and useful pursuit."

The Civil Engineer and Architect's Journal.

" Mr Hay's book is the fourth edition of a work decidedly esteemed for its practicability, cheapness, and the soundness of its principles ; and to it is added, in this edition, an excellent treatise on house-painting. It is, indeed, the cheapest and best book on the subject, and one to which our readers of all classes, may refer with advantage and delight."

The Architectural Magazine.

" It is impossible to peruse the work before us, without being convinced that the author is thoroughly acquainted with the science of his art. We have given as distinct an idea as we can of Mr Hay's Treatise, without the aid of his coloured plates ; and we have done so with a view of showing every young architect, or other person connected with houses or furniture, how much they may gain from Mr Hay's book. In short, there is no other such work on the subject of which it treats, and none of which it may be so truly said, that it ought to be in the hands of every one at all connected, however remotely, with building or furnishing. We repeat, that we cannot too strongly recommend Mr Hay's work to our readers."

The Edinburgh Chronicle.

" Mr Hay has struck out new lights as to his profession, and has shown in this publication that the business of a house-painter should be founded on science, and regulated by laws, as well as the higher departments of art. And, what is more, he is the great sublime he draws. In his own extensive business, he has carried most successfully into effect those great principles which he has so well developed in the work before us ; indeed, his own bright example has done, for the art of " Harmonious Colouring," in this city and neighbourhood, more than has been effected by his predecessors in the same profession for centuries. This book and his example combined will, in fine, form an era in the history of the art to which they refer, and dignify a business which has hitherto been conducted without repute and without science."

NOTICES OF "THE NOMENCLATURE OF COLOURS," &c.

The Scotsman.

"Here is another professional work by Mr Hay, and one distinguished by all the characteristics by which his other works recommend themselves to public notice and favour— vigour, originality, and an entire and thorough mastery of his subject.

"The work is enriched by a series of plates, on which are exhibited specimens of the various colours referred to in the text. These are tastefully got up, and are marked by a precision which must render them extremely useful for practical purposes. Taking the work altogether, there can be no doubt of its being one of the very best of its kind that has yet been presented to the public. The amount of practical knowledge it contains, and the masterly way in which that knowledge is placed before the reader, cannot fail to impress him with sentiments of the highest respect for the talents and acquirements of the author. Nor will these sentiments be weakened by noting the philosophical spirit in which, when opportunity offers, he treats his subject; affording in this, evidence of an order of intellect equal to much greater things than the demands of his profession."

The Courant.

"The whole tenor of the work evinces on the part of the author a sincere desire to advance art, a spirit of genuine philosophy, and a lively appreciation of the beautiful. Never before has been exhibited so systematic, so complete, so satisfactory an arrangement of colours. The whole of the chromatic scale through all its gradations and modulations is shown. Its melodies, harmonies, and contrasts, are all clearly defined. All the individual colours, tints, and hues, are placed in their proper position, extending through a series of two hundred and forty. The arrangement is so skilful, that the eye wanders delighted over them all, from the fiery and exciting colour of red down to the most gentle and retiring of the neutral tones."

The Glasgow Constitutional.

"This, perhaps, will be found to be the most generally useful of the many valuable and very ingenious works with which its indefatigable author has, within these few years, enriched our literature. It so far surpasses all previous attempts of the kind as to preclude any comparison with them.

"The book addresses itself more immediately to those engaged in the study of the arts, sciences, and manufactures; and of its value and importance to this class of persons we need say nothing. But we would strongly recommend it also to the attention of all who take an interest in objects of taste, as containing an amount of information which they will find nowhere else, and from which even those whose eye has been most carefully cultivated in the perception and discrimination of colour, will find that they have much to learn."

Edinburgh Weekly Journal.

"Mr Hay may in his works, both as an artist and an author, be almost considered as the founder of a new department of design, which, though inferior in ambitious pretence to the historic or landscape painter's, is perhaps more conducive to the general amenity and improved civilization of our social condition, for his object is to define and explain the laws on which grace, proportion, and beauty depend, and to apply them to all means of decoration, from the magic combinations of the crowded gothic arch —where apparent confusion is ever blending into exquisite harmony—to the delicate tintings and associated hues which make even the paper-stained walls of the drawing room a continued challenge to criticism, and delight to the eye of taste. That he was thoroughly master of his subject, the warm approbation which has greeted his works on Harmonious Colouring, Form, Proportion, &c. sufficiently evinces; and the present work may be considered as the practical application of some of the theories propounded, as, after teaching his disciples how to use their tools to produce the best effects, he here gives the tools themselves, viz. colours, mapped out, arranged, classified, and described, not only as to the essential composition, qualities and effects of each, but also its relations to its neighbour and its antagonist tints, and the exact influences over all by the interference, more or less, of the two great opposites, black and white, darkness and light."

The Glasgow Argus.

"Mr Hay is not alone a patron of the arts, but as an instructor of the followers of art, he is a benefactor to the public. All his works, whether he writes upon Ornamental Design, or the Harmony of Form, the Laws of Harmonious Colouring, or brings his comprehensive mind to bear analytically upon the Geometric Principles of Beauty, while they improve and delight the reader, render him the more capable of being of use, by extending his sphere of action, and placing him nearer that perfection it must be the constant aim of every artist to arrive at.

"The primary colours are taken by Mr Hay in their natural order; and not only will the artist and connoisseur find ample material for thought, but the naturalist, the mineralogist, and the botanist, will discover new lights opened out to him of the most valuable tendency."

Edinburgh: Printed by Macpherson & Syme.

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EXAMPLE I.

THE PRIMARY AND SECONDARY COLOURS.



D.R.Hay Inv.t

Lizars Sc.

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EXAMPLE II.

THE SECONDARY COLOURS CONTRASTED WITH THE PRIMARY HUES.



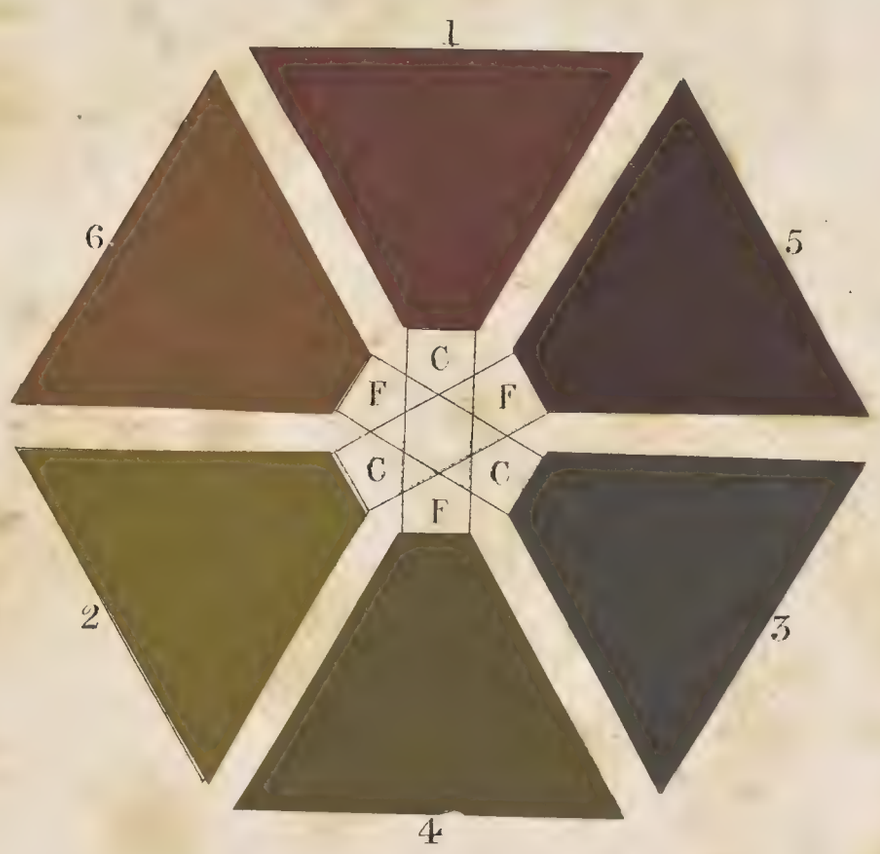
D.R Hay Invt. Lizars Sc.

3107

LOAN

EXAMPLE III.

THE PRIMARY AND SECONDARY HUES CONTRASTED.



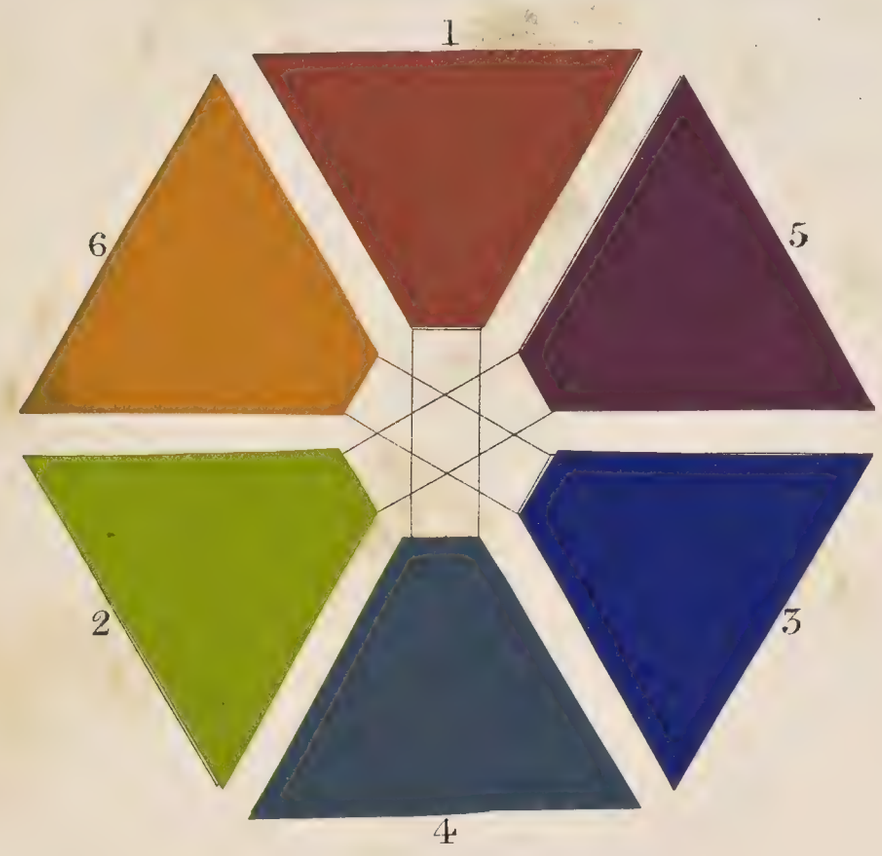
D.R.Hay inv.t

Lowes Sc

Lorem

EXAMPLE IV.

BINARY MODIFICATIONS
OF
THE SECONDARY COLOURS.



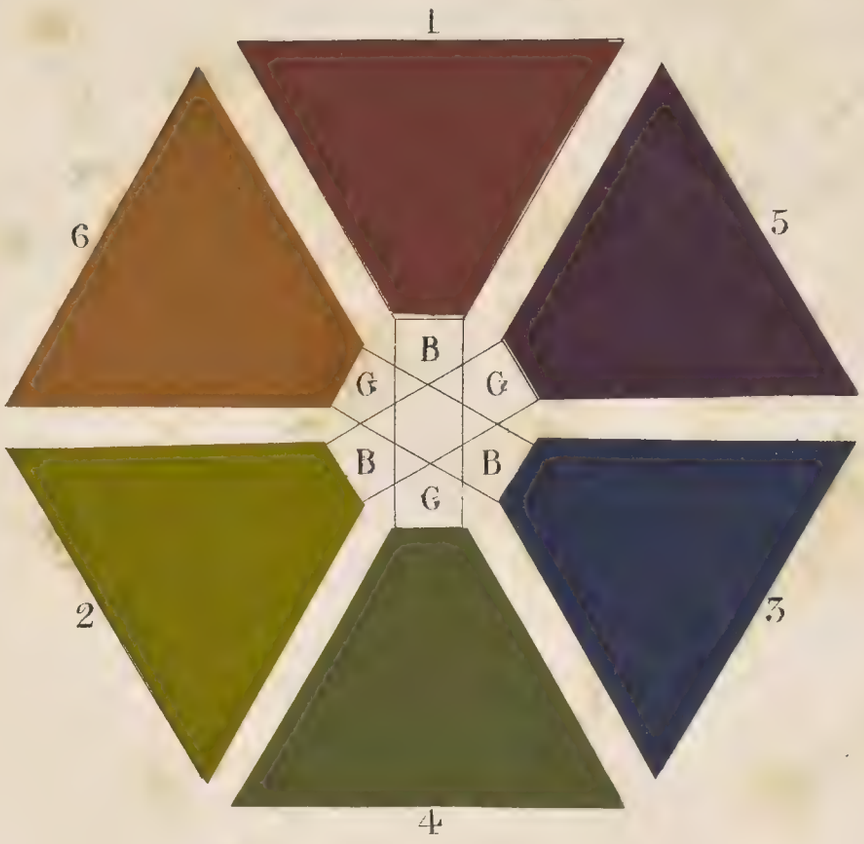
D.R.Hay Invt.

Inv 3107

3107

EXAMPLE V.

THE PRIMARY AND SECONDARY COLOURS TEMPERED.



D & Hay Lith.

Lizars Sc

3107

Fin 3107

EXAMPLE VI.

THE PRIMARY COLOURS CONTRASTED WITH THE TEMPERED SECONDARIES.



D.R.Hay Del.t

Lizars Sc

3107

3107

EXAMPLE VII.

THE SECONDARY COLOURS CONTRASTED WITH THE TEMPERED PRIMARIES.



D.R.Hay inv.t

Linnes Sc.

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EXAMPLE VIII.



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EXAMPLE IX.

HARMONY OF THE PRIMARY RED.



D.R.Eaj Inv.t

Lizars Sc.

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EXAMPLE X.

HARMONY OF THE SECONDARY GREEN.

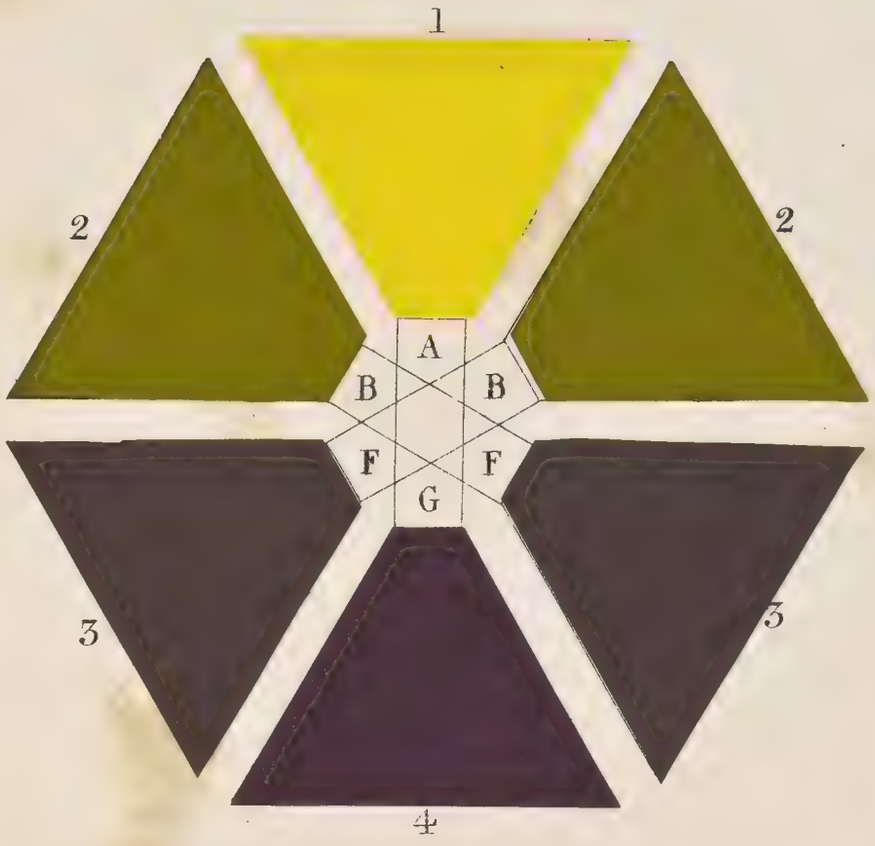


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EXAMPLE XI.

HARMONY OF THE PRIMARY YELLOW.



D.R. Hay Invt.

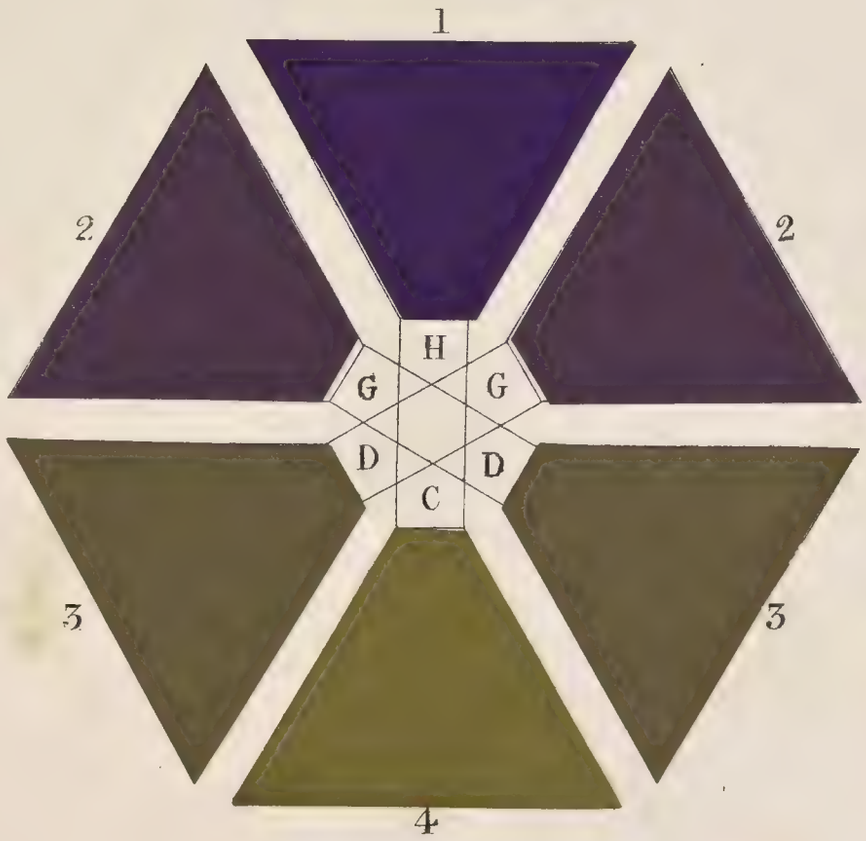
Jazzey Sc.

W no 3107

LOISEAU

EXAMPLE XII.

HARMONY OF THE SECONDARY PURPLE.



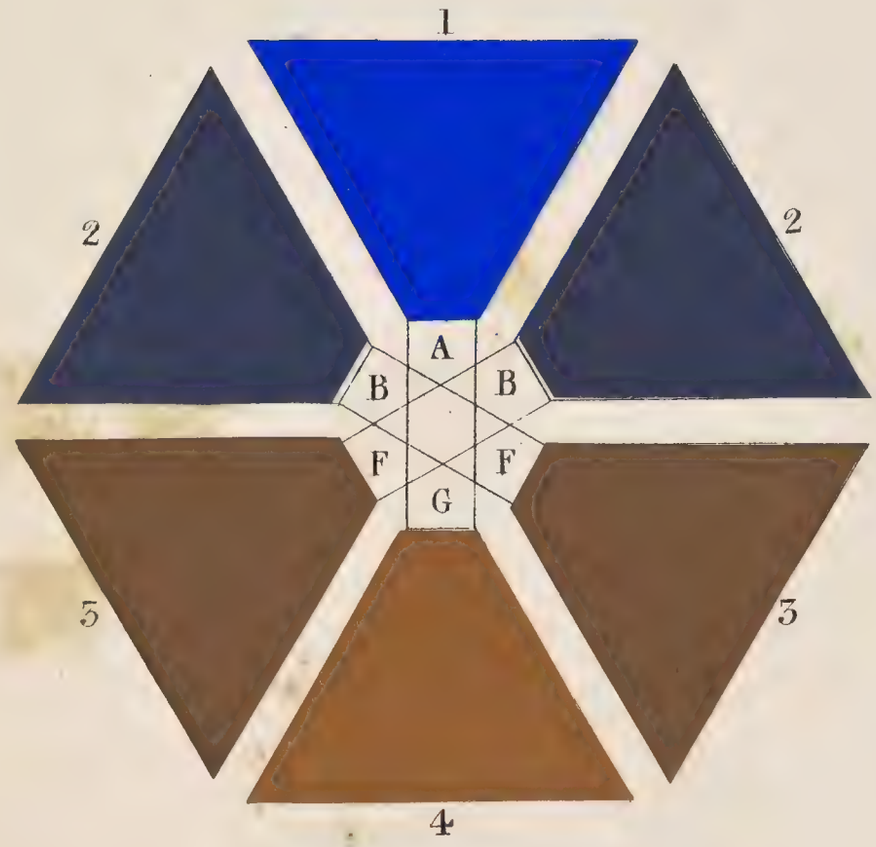
D.R.Hay Inv.t

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EXAMPLE XIII.

HARMONY OF THE PRIMARY BLUE.



D.R. Harry Sc. &c.

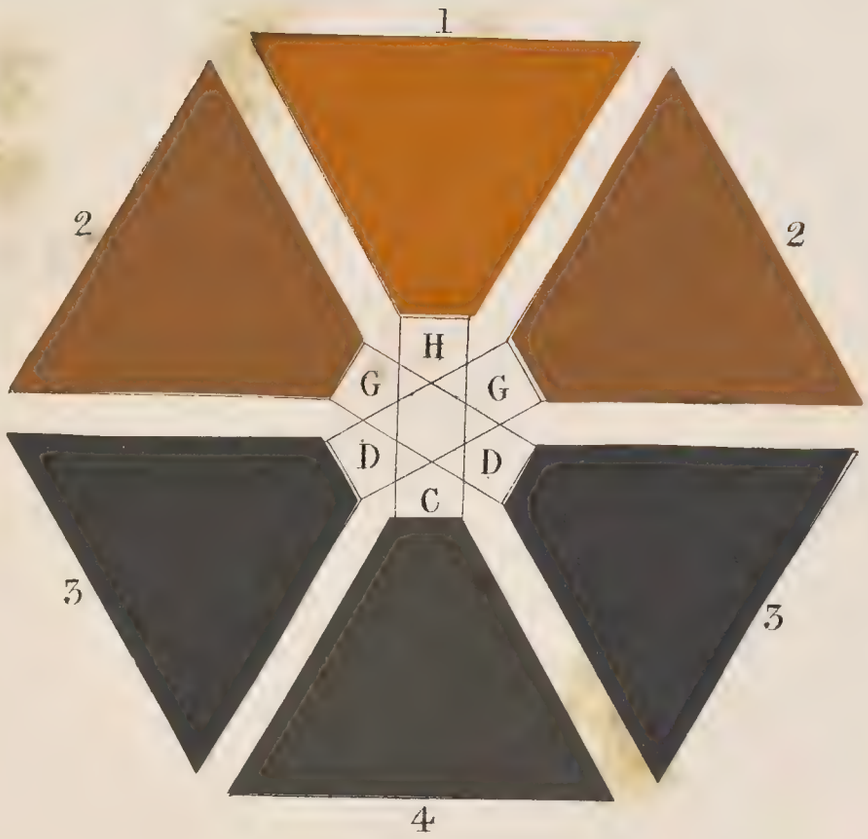
Linnæus Sc

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EXAMPLE XIV.

HARMONY OF THE SECONDARY ORANGE.



Brooking Inv.

Vizars Sc.

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HAY'S
PRINCIPLES
OF
COLOURING